

Adaptation reporting power

Direction to report

Thames Water's response



January 2011



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Executive Summary

This report describes the current and future predicted impacts of climate change for Thames Water. It also illustrates how climate change risk is embedded within our business processes and describes our current and potential future responses with respect to adapting to climate change.

Some climate change impacts are unavoidable because of historical greenhouse gas emissions and will lead to variations in patterns and frequencies of droughts and other extreme weather events. Moreover, because of Thames Water's intimate dependence on the natural environment, the impacts of climate change will be felt throughout our business. As a consequence of these projected changes in future climate, we have identified that we will have to deliver appropriate adaptation measures in order to protect public water supplies and the environment in the future. This means working hard to ensure that we build our understanding of the implications and use it to make decisions based on sound science.

Our approach to climate change has not been developed solely as a response to the Adaptation Reporting Power Direction. Nevertheless the production of this report while not leading to a fundamental change in the management of climate risk within Thames Water has provided a valuable opportunity for reflection and iterative refinement of our approach and understanding.

In this report, we describe in detail our approach to risk both in terms of general business risk but also specifically climate change risk. We have demonstrated that our understanding of and response to climate change is embedded in our overall approach to managing business risk. In doing so, we show that we are committed to high standards of corporate governance in the management of key risks to the appointed business.

There will always be uncertainty about the size, rate of change and timing of climate change impacts. Because of this uncertainty, there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. There are also concerns regarding the timeliness of response (too early) or the degree of response (too much) and potentially wasted adaptation investment, which for a regulated business will ultimately impact on customer bills. However, this need's to be balanced with the need to encourage and ensure adaptation responses are in place in sufficient time.

The risk to our business associated with climate change is only one of many and must not be considered in isolation. Indeed, there is a danger that if the focus is solely on climate change then perhaps other nearer term risks could be overlooked. However, by iteratively reviewing

the impact of climate change on our business we expect to be able to flexibly manage our climate change response.

The challenge going forward will be to find a way of balancing in a sustainable way the challenges of climate change together with:

- what customers want and their willingness to pay;
- operational risks and business needs to operate efficiently and effectively;
- financing our business our business efficiently; and
- other environmental outputs including those related to water abstraction, effluent discharges and greenhouse gas emissions

This will not be easy. Nor can we achieve this balance working in isolation. We will therefore work positively with Government, regulators, customers and other stakeholders. If we work together, we will be able to adapt to the impacts of climate change successfully.

We confirm that we have had regard to Statutory Guidance from the Secretary of State produced under Section 61 of the Climate Change Act, 2008 in the production of this report.



1. Statement of Compliance with the Adaptation Reporting Power

The Climate Change Act 2008 gives the Secretary of State the power to direct reporting authorities (organisations with functions of a public nature and statutory undertakers) to produce reports on:

- the current and future predicted impacts of climate change on their organisation; and
- proposals for adapting to climate change

When reporting, an authority must have regard to Statutory Guidance from the Secretary of State. The authority must then consider its report when carrying out its functions. This power is the primary legislative lever available to the Government to influence behaviour on climate change adaptation.

Thames Water is an identified reporting authority and was directed to report by the Secretary of State in March 2010.

1.1. Statutory Guidance to Reporting Authorities 2009 - Legal basis

1. Section 61 of the Climate Change Act provides that the Secretary of State may give reporting authorities guidance about:

- (a) Assessing the current and projected impact of climate change in relation to the authorities' functions;
- (b) Preparing proposals and policies for adapting to climate change in the exercise of their functions; and
- (c) Co-operating with other reporting authorities for that purpose. This section does not apply to devolved functions.

The Secretary of State discharged this requirement when he issued 'Adapting to Climate Change: helping key sectors to adapt to climate change' in 2009. Reporting authorities are required to have regard to the Guidance in developing risk assessments and programmes for adapting.

The guidance gives further detail about the content that Reporting Authorities should include in their reports in the following general areas:

- functions impacted by climate change;
- approach; Summary of risks which affect functions, mission, aims, and objectives;
- actions proposed to address risks;
- uncertainties and assumptions;



- barriers to adaptation and interdependencies; and
- monitoring and evaluation

We have followed this guidance and describe its application in Section 3 Report Overview.

The Secretary of State also has the power to update this Guidance. However, it is intended that the Guidance contained in this document remains in place for some time – years rather than months - to reduce the regulatory uncertainty that frequent changes could produce, but also because of the broad nature of the Guidance which reduces the need for change.

1.2. *Statement of Compliance*

We confirm that as an organisation with functions as a statutory undertaker for water and wastewater services we have produced a report on the current and future predicted impacts of climate change for our organisation; and we have included proposals for adapting to climate change.

We also confirm that we have had regard to Statutory Guidance from the Secretary of State produced under Section 61 of the Climate Change Act, 2008.



2. Summary

As an organisation with functions as a statutory undertaker for water and wastewater services this report describes the current and future predicted impacts of climate change for our organisation. It also illustrates how climate change risk is embedded within our business processes and describes our current responses and potential future proposals with respect to adapting to climate change. During the preparation of this report we have had regard to Statutory Guidance from the Secretary of State produced under Section 61 of the Climate Change Act, 2008.

We are the UK's largest water and wastewater Services Company serving London and the Thames Valley. Every day, we supply 2,600 million litres of tap water to 8.7 million customers across London and the Thames Valley. We also remove and treat 2,800 million litres of sewage for an area covering 13.8 million customers. Our 349 sewage treatment works include Beckton, in East London, which is the largest in Europe.

Some climate change impacts are unavoidable because of historic greenhouse gas emissions and will lead to variations in patterns and frequencies of droughts and other extreme weather events. Because of Thames Water's intimate dependence on the natural environment the impacts of climate change will be felt throughout our business. As a consequence of these projected changes in future climate we have identified that we will have to deliver appropriate adaptation measures in order to protect public water supplies and the environment in the future. This means working hard to ensure that we build our understanding of the implications and use it to make decisions based on sound science.

Our 25-year Strategic Direction Statement, *Taking Care of Water*, published in December 2007, identified the potential climate change impacts on our business and the actions that we believe we need to take to ensure that we mitigate and adapt effectively and responsibly. The business plan we submitted to Ofwat as part of the PR09 process directly built on the findings of *Taking Care of Water*. Three areas of focus identified through this process were: water resource planning (to protect the security of future water supplies such as rivers and groundwater), sewerage design and flood resilience.

In the preparation of our 25-year Strategic Direction Statement, Final Business Plan for PR09, Water Resource Management Plan and Drought Management Plan we have consulted widely with our stakeholders and have actively sought to accommodate issues highlighted by this process in our response to climate change impacts.



Approach - Our approach to climate change has not been developed solely as a response to the Adaptation Reporting Power Direction. We have included responses to climate change impact in our business planning since as long ago as 1997. This has included answering five key questions in order to understand and respond effectively to the impacts of climate change:

1. what is climate change and how will it manifest itself?
2. what are the potential business impacts/issues associated with it for us?
3. how significant are these impacts?
4. what is the business already doing that will minimise the impacts?
5. how can we manage this challenge in a strategic way?

Although our approach is aligned with the five yearly planning cycles of our regulators we have also taken a longer 25 year view of climate change impacts as part of our planning for PR09.

In this report we have described in detail our approach to risk both in terms of general business risk but also specific climate change risk. The areas covered included: Business Risk Assessment, Asset Operating Risk, Water and Wastewater Risk Framework, Operational Risk Assessment, Flood Risk Planning/Screening/Analysis/Management. The risk to our business associated with climate change is only one of many and must not be considered in isolation. There is a danger that if the focus is solely on climate change then perhaps other nearer term risks could be overlooked.

We are committed to high standards of corporate governance in the management of key risks to the appointed business. In this report we have demonstrated that our understanding and response to climate change impacts and risk is embedded in our overall approach to managing business risk. The report explores with evidence, how we manage key risks in the context of our business as a whole looking at: Investment Planning and the Development of our Business Plan for PR09; Developing Water and Risk Frameworks; Bottom Up Operational Risk Assessment; Our Risk Management Procedures; Major projects; Cost Benefit Analysis Overview; Climate Change Impacts and Flooding; Framework to Assess the Risk of Flooding at Critical Assets; Climate Change Impacts on Water Resources; Changes in Rainfall Intensity and Impacts on the Sewerage Network; Headroom Analysis – Accommodating Climate Change; The Wider Context - Developing our PR09 Business Plan; and Working in Partnership to Understand Climate Change.



This risk assessment, undertaken as part of the preparation of this report, reinforced the original assessment used in the preparation of our PR09 business plan and validates the actions being taken between now and 2015 in the areas of:

- water resource planning (to protect the security of future water supplies such as rivers and groundwater);
- sewerage design; and
- flood resilience

Our analysis so far has established that climate change is predominantly a risk for our business with very few opportunities being identified. The main opportunities that we have identified are around carbon mitigation e.g. renewable energy generation and adaptation as a consequence of potentially more raw water being available for collection during the winter period and greater dilution capacity in the river during the winter period to dilute treated effluent.

During our assessment of UKCP09 we have identified that thresholds in changing climate are not that useful for planning. It is essential for businesses to understand how sensitive its activities and supporting systems (natural and business) are to climate change. With this information we will be able to develop decision making threshold points which would trigger the implementation of adaptation responses. We believe that this is a key learning point for other organisations.

Indicative costs for adaptation to climate change impacts associated with; Flooding, Water Resources and Sewerage Networks(our priority areas for action) included in our Final PR09 Business Plan (but not necessarily funded) were just under £300 million.

Sustainability and Risk - Looking forward we have started the process of delivering adaptation solutions as part of our AMP5 Capital Programme. This is a defined programme which is monitored by the Executive Management Team on a monthly basis with primary responsibility for delivery sitting with our Asset Management Director.

In our final Business Plan we explained the importance of sustainability for our business and identified a number of new challenges that will have sustainability implications for our business for the period from 2010-15 and beyond. These challenges included:

- adapting to the inevitable impacts of climate change, and mitigating our avoidable contributions to climate change;



- responding to tighter legislation across a broad range of environmental issues; and
- challenging the way we operate in order to respond to social and demographic change (such as population growth and changes in household occupancy) and evolving customer expectations

Sustainability will guide our long-term strategy and business planning into the future. It is fundamental to the way we run our business and our approach for AMP5. This is reflected in our Strategic Direction Statement ('Taking care of water'), Business Plan, Sustainability Assessment Framework and broader business activity.

The development of our Business Plan for PR09 has taken into account the proposals in the Climate Change Act 2008 describing how public bodies and statutory undertakers need to carry out their own risk assessment and make plans to address the risks associated with climate change.

One of the most significant drivers for investment in our revised Business Plan is the forecast impact of climate change on both water available for use and the demand for water. Ofwat determined not to include water resources investment with a climate change driver within price limits until cases could be reworked with the UKCP09 projections. Therefore there remains uncertainty about what water resource adaptation will be delivered before 2015. However, we are now developing our assessment of the impacts of climate change on water resources using the UKCP09 projections with Ofwat, Environment Agency and UKCIP. This work will inform our decision whether to submit a proposal to Ofwat for an Interim Determination of K as a Notified Item.

Our flood resilience work used to inform our final Business Plan was based on best practice modelling of the flood extent and depth at 3842 of our operational sites. This has incorporated both fluvial and pluvial flooding. We have taken a pragmatic approach of adopting flood resilience rather than flood resistance, and only sought to protect sites when there are clear operational reasons for doing so. Our proposed flooding resilience is based on Ofwat's 3-staged approach for flood hazards assessment or Service Risk Framework (SRF) planning methodology, best value solution and cost benefit analysis, and hence our AMP5 investment focuses on our most critical assets.

In AMP5 we will uplift our design standard for sewer flooding schemes to provide alleviation up to a 1 in 30 year storm event. In addition we intend to review the need for additional uplift over and above this as soon as analysis with the UKCP09 data can be completed. Throughout AMP5, we also plan to improve our understanding of our catchments through our



Drainage Area Planning programme. Moving forwards 'more of the same' e.g. building greater capacity into pipes and tanks, should not be the only adaptation response to climate change. For AMP6 and beyond other options including sustainable drainage systems (SuDS), storm water charging and redesigning catchments and buildings will become viable sustainable options to alleviate the risk of sewer flooding.

The indicative adaptation benefits from schemes delivered as part of the AMP5 programme will be in place by 2015. Delivery of adaptation projects beyond 2015 have yet to be developed, costed, funded or confirmed. Without funding it is unlikely that it will be possible for them to be delivered.

Uncertainty - In developing a response to climate change there are a number of significant uncertainties and assumptions that have to be taken into account. We have considered the implications of climate change throughout the development of our final Business Plan for PR09. The UKCIP02 climate change scenarios predict that, by the 2050s, summers will become drier (by 20-40%) and winters will become wetter (by 10-20%). For the purposes of our PR09 business planning, we assumed that the impact of the then unpublished UKCIP climate change projections (UKCP09) would be broadly consistent with UKCIP02 scenarios. We spoke with both the Hadley Centre and UKCIP who broadly supported this assumption.

The UKCP09 projections have not reduced the uncertainty associated with future climate change. They have essentially only managed the uncertainty related to the underlying modelling and provided envelopes of probability distributions of future climates. The uncertainty surrounding how different the future climate will be remains. For more information describing how we are approaching the use of the outputs from UKCP09 please see case study '*Using UKCP09 (Evaluating Risk from Climate Change on Water Supply-Demand)* on [page 153](#)'.

To calculate the water supply-side impacts for our Final Business Plan, the Company adopted the UKWIR06 methodology (which it helped develop through UKWIR) as recommended in the Environment Agency's Water Resources Planning Guideline. The approach to uncertainty is of fundamental importance in supply demand planning. The approach taken in developing our final Business Plan and Water Resource Management Plan followed the latest water industry methodology, which uses a margin of safety, including an allowance for climate change, termed 'Target Headroom' as a buffer between supply and demand.

Until more accurate data is available to allow us to model the effect of climate change on our wastewater assets we cannot promote schemes or put a cost on the impact effectively. The



primary impact of climate change in this area will be on sewer infrastructure. We believe that simply delivering “more of the same” i.e. building greater capacity into pipes and tanks will not be either sustainable or feasible. During AMP5 we will develop better data and explore new solution options that we will incorporate into our AMP6 planning onwards. This will help ensure that we do not maladapt our sewerage network to climate change impacts.

Until the review of Ofwat has been concluded and the Environment Agency has completed we have assumed that the regulatory regime will be predominantly similar to that in 2010. We have not assumed any impact as a consequence of the Comprehensive Spending Review as this is currently unforeseeable. In addition we have assumed that we need to deliver the same Level of Service to customers and the environment. There is an underlying assumption that we will be given full funding through the price review process for identified adaptation solutions.

Barriers - There will always be uncertainty about the size, rate of change and timing of climate change impacts. Because of this uncertainty there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. There are concerns regarding the timeliness of response (too early) or the degree of response (too much) and potentially wasted adaptation investment, which for a regulated business will ultimately impact on customer bills. However, this must be balanced with the need to encourage and ensure adaptation responses are in place in sufficient time.

Lord Krebs (the Chairman of the Climate Change Committee) has highlighted that it is important to recognise that even well adapted societies (and this could read companies) will suffer some disruption from climate change as a consequence of natural variability. Our approach to understanding and managing the impacts of climate change is to try and ensure that these impacts are minimised as far as possible. To help regulated businesses manage uncertainty appropriately without the need to provide disproportionate levels of evidence there is a need for clear unambiguous guidance and leadership from Government and Regulators.

During PR09 this position was compounded further by the continual delay in the publication of what would become UKCP09, the requirement to use the projections and the expectations of the user community. We believe that the concept of using best “available” science has been undermined as a consequence and has become a barrier to companies developing appropriate adaptation responses as there may be better data available in the future. This perpetuates “crystal ball” gazing to seek an unachievable certainty about the future in terms of size and timing of climate change impacts. There will always be better information about



climate change in the future but this should not become a barrier to making decisions. Therefore we would urge the Government to direct regulators to accept proposals based on “the current best available science” at the start of planning cycles. Without this, given other externalities such a planning, population growth etc, there is real potential that appropriate adaptation responses will be delayed due lack of funding.

For business the publication of the UKCP09 projections is not the end of the process it is only the start. The amount of work and understanding required to apply the outputs has been severely underestimated not only by business but also by Government and Regulators. Since 2009 we have been working with Ofwat, the Environment Agency, UKCIP, leading academics and consultants to understand how to apply the new projections to business planning for water resources to determine the thresholds and sensitivities of our systems to climate change.

There is a need for the approach to Cost Benefit Analysis (CBA) to be reviewed as a matter of urgency and we understand that Ofwat have plans to do so which we would support. There is also a need for it to be clear from the outset how the analysis will be applied and used to determine funding to ensure clarity, transparency and fairness. More generally the use of CBA has also raised questions regarding protection of critical infrastructure, should it be protected at any cost and if so how this should be funded? We would be very happy to work with Government to clarify this position to help remove further barriers to adapting to increased flood risk in the future and to deliver cost effective solutions on the ground.

There is a misalignment of regulatory cycles for Periodic Reviews, Water Resource Management Plans and Water Framework Directive in terms of both frequency and length of cycle. This together with lack of understanding of primacy of cycles is contributing to significant conflicts about objectives and inefficiency in planning and delivery. There is a need for clear and pragmatic leadership from Government to provide clarification and direction. Given the current economic climate this is even more important than it has been previously.

The provision of information and general direction to those regulated organisations seeking to ensure that they adapt their businesses is insufficiently clear. There must be an a clear, transparent and unambiguous overarching framework which can be used by organisations in their planning processes which is accepted by Ministers, Government Departments and Regulators in advance of each planning round. This should include the requirement to take these misalignments into account when directing regulated businesses. We would be happy to work with Ministers, Government Departments and Regulators to overcome this problem.



The Committee on Climate Change Adaptation Sub-Committee (ASC) has identified a range of further action required by Government. They identified that action by local authorities, public sector agencies, businesses and individuals will be essential to ensuring that the UK is preparing adequately for a changing climate. Specifically they advised that the Government should work to remove barriers and provide stronger signals to enable action by others, including:

- establishing a process for defining adaptation outcomes, for example what level of flood risk is acceptable;
- helping deliver these outcomes by: (i) promoting greater capability and capacity in priority areas where progress has been slow, and (ii) ensuring decision-makers have practical tools and information to quantify key climate risks and manage uncertainties;
- ensuring that the new delivery arrangements, for example in land use planning and infrastructure provision, allocate responsibilities for adaptation clearly and provide for sufficient cooperation by organisations at landscape or catchment scale; and
- considering how upcoming policy reforms can support adaptation, for example in the White Papers on water, the natural environment and public health, and in any review of building regulations

We support the advice the ASC has given to Government particularly with respect to, but not limited to, Critical National Infrastructure and what level of flood risk is acceptable, in anticipation of drier summer and wetter winters that robust options that increase capacity of a water storage system (a response described as robust by the ASC) and the removal of barriers to effective adaptation, such as short term thinking, insufficient price signals and obstructive regulations, in order to incentivise and allow action .

Monitoring and Evaluation - As a business we assess and report externally on our response to climate change on an annual basis to Ofwat as part of the June Return process and through our voluntary Corporate Responsibility report.

The management of climate change risks is increasingly becoming embedded across our business and is evidenced in a number of ways in this document including:

- there is a senior member of the Executive team with explicit responsibility for climate change;
- a published climate change policy which is reviewed annually;



- we have produced a 25 year forward look at our business which explicitly includes climate change adaptation; and
- risk assessment and response plan development

By constantly reviewing the impact of climate change on our business using a variety of assessments and response development mechanisms including, risk assessments, the development of five and twenty-five year plans, continual asset monitoring, research and external assessment, we expect to be able to manage our climate change risks flexibly. The production of this report has not led to a fundamental change in the management of climate risk within Thames Water. It has provided an opportunity for reflection and iterative refinement of our approach and understanding.

We have established a Risk & Value team which is tasked with ensuring that climate change impact is considered in our asset investment decision making, as part of business as usual activities going forward.

The challenge going forward will be to find a way of balancing in a sustainable way the challenges of climate change together with:

- what customers want and their willingness to pay;
- operational risks and business needs to operate efficiently and effectively;
- financing our business our business efficiently; and
- other environmental outputs including those related to water abstraction, effluent discharges and greenhouse gas emissions

This will not be easy. Nor can we achieve this balance working in isolation we will work positively with Government, Regulators, Customers and other stakeholders. If we work together we will be able to adapt to the impacts of climate change successfully.



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3. Report Overview

The guidance gives specific detail describing what Reporting Authorities should include in their reports (Statutory Guidance, Box 2 – What to include in a report, page 14 and Annex B – Statutory Guidance: Cover Sheet, page 30). To ensure transparency between this Main Report and the Summary Report (or coversheet) we have set out the report using broadly similar headings to those suggested in the Statutory Guidance. To help guide the reader through the report the following section outlines in more detail what each section of the report contains.

In Section 4 – Introduction (including functions impacted by climate change,) we describe Thames Water's functions, mission, aims, and organisational objectives as requested in the Direction. Additionally we also describe the context of our existing business in relation to expected climate change impacts. We also introduce the concept of climate sensitivities/thresholds above which climate change and weather events will pose a significant threat to our business e.g. with respect to flooding resilience. We go on to cover this in greater detail in Section 5 – Approach. In the final part of this section we describe engagement with our stakeholders and the important interaction with them on climate change.

In Section 5 – Approach, we describe in detail the evidence, methods and expertise we have developed and used to evaluate climate change. We also highlight and discuss the context and time over which we had already been assessing the implications of climate change on our business and potential adaptation responses going as far back as 1995, well before the Direction to Report. As requested in the Direction in the second part of this section we explain how we have attempted to quantify, estimate or characterise the impact and likelihood of climate change risks occurring. We also explain how we evaluated the costs and benefits of proposed adaptation options. The concluding part of this section explains how we have been working with other stakeholders to improve our understanding of climate change.

In Section 6 - Summary of risks which affect functions, mission, aims, and objectives, we describe the strategic risks from climate change facing Thames Water using a likelihood/consequence matrix which also, where possible, includes thresholds. We also identify short and long term impacts of climate change and sign post how these have been factored into our overall adaptation response. The likelihood and consequences are quantified as far as possible together with an assessment of the level of confidence (high/medium/low) in the assessment. Also in this section we identify our priority climate-related risks and why they have been prioritised as such together with a description of the actions we are taking to tackle the impact of climate change. Where applicable we have



identified opportunities which have been identified as a consequence of responding to climate change impacts.

In Section 7 - Actions proposed to address risks, we describe actions proposed to address risks that we expect to deliver before 2015. We also describe how our adaptation plans are linked to our wider sustainability objectives and the benefits we expect the measures to bring to the business. In addition we cross reference with Section 6 where we identified our key climate change risks and the timescales over which the impacts will occur and that we need to respond together with some indicative costs and our longer term adaptation plans described in Section 11 and our Strategic Direction Statement.

In Section 8 – Uncertainties and assumptions we describe the main uncertainties in the evidence, approach and method used in the adaptation programme and in the operation of our organisation. We also highlight the assumptions that have been made when devising the programme for adaptation.

In Section 9 - Barriers to adaptation and interdependencies we describe the barriers we have identified to successfully delivering adaptation responses. Where possible we describe opportunities to overcome these barriers. We also highlight a number of interdependencies that need to be considered including our key stakeholders.

In Section 10 - Monitoring and evaluation we describe how we monitor and report on the progress of our adaptation programme. We explain how the management of climate change risks are embedded in our business. We describe how through the monitoring and risk assessment process we are able to review potential impact thresholds and incorporate them into future planning and risk assessment activities. We summarise how we expect to manage our response to climate change in a flexible way.

In Section 11 – Ongoing development and areas of further work we describe the activities we anticipate that we will be working on to improve our adaptation preparedness to the impacts of climate change. Although we have only just started the current AMP period we are already planning for the next Periodic Review Process (PR14). This includes how we assess the impact of climate change on our activities and what our sensitivities and thresholds are in relation to them.

4. Introduction (including functions impacted by climate change)

In this section we describe Thames Water's functions, mission, aims, and organisational objectives as requested in the Direction. Additionally we also describe the context of our existing business in relation to expected climate change impacts. We also introduce the concept of climate sensitivities/thresholds above which climate change and weather events will pose a significant threat to our business e.g. with respect to flooding resilience. We go on to cover this in greater detail in Section 5 - Approach. In the final part of this section we describe engagement with our stakeholders and the important interaction with them on climate change.

4.1. About Thames Water

We are the UK's largest water and wastewater services company serving London and the Thames Valley. In the year ending March 2010 we had a turnover of £1,624 million and operating costs of £953 million with a profit for the financial year of £331 million.

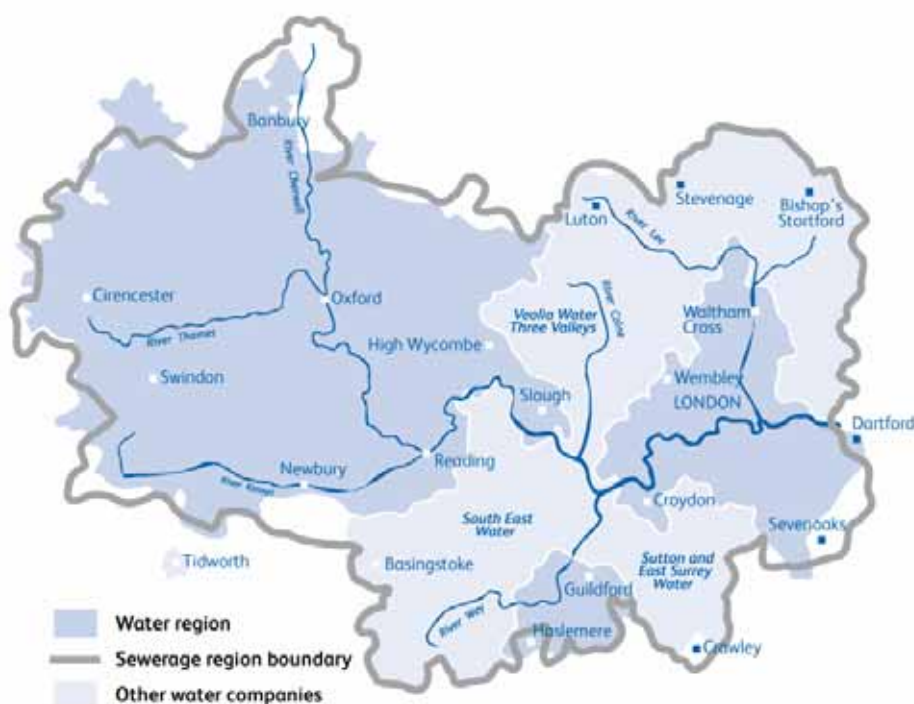


Figure 1 Our Operational Area



Our role in providing water and sewerage services means we play a vital part in the lives of millions of people across our 13,750km² operational area (see Figure 1). Every day, we supply 2,600 million litres of tap water to 8.7 million customers across London and the Thames Valley, carrying out over 500,000 tests per year to ensure our drinking water meets stringent UK and European standards. We also remove and treat 2,800 million litres of sewage for an area covering 13.8 million customers. Our 349 sewage treatment works include Beckton, in East London, which is the largest in Europe.

4.1.1. Our Proposition (Who we are and what we do)

Thames Water is the water and sewerage services business that delivers water of the highest quality reliably and recycles it safely back to the environment. We provide an essential service to society that represents exceptional value for all our 13.8 million domestic and business customers. The in-depth knowledge of our people, founded on 150 years of service and forward-thinking approach, ensures that we will continue to meet the needs of our customers, so that we are always the water company of choice for customers and investors.

4.1.2. Our Vision (What we want to achieve)

If our customers had a choice, they would choose Thames Water.

4.1.3. Our Mission (How we will achieve it)

To provide the best-in-class water and sewerage service that is profitable, sustainable and acts in the long-term interests of both our customers and the wider community. To achieve this we will:

- work closely with customers and stakeholders
- deliver services at a reasonable cost
- do what we say
- develop the best team
- be innovative
- invest in the right tools to get the job done well
- educate and inform the public
- improve financial performance
- be efficient and complete projects on time

4.2. How we are regulated

The water sector is highly regulated and is required to develop and agree its plans with key regulators as described below. This is against a backdrop of responding to climate change, tackling leakage, improving water efficiency and delivering high-quality customer service. These areas have been identified as the top priorities for the company and our customers for the future. We use our planning for the Periodic Review, Water Resource Management Planning and Drought Planning processes to incorporate the impact of climate change into our business planning processes.

4.2.1. Periodic Review

The water industry currently works in five-year planning cycles, in which proposals are submitted to our economic regulator, Ofwat. These proposals are reviewed by Ofwat, which decides by how much the level of bills should change to pay for the work required. Like other companies, we submitted our final business plan in 2009, outlining our investment proposals for the period from 2010 to 2015 (often referred to as AMP5). The plan explains how we aim to address the priorities of our customers, meet the requirements of new legislation, provide water and wastewater services for our region's growing population, and accommodate the expected challenges of climate change. For details of this, visit www.thameswater.co.uk/ourfiveyearplan. Ofwat gave its decision in a 'final determination' which sets limits for customers' bills for the five-year period from 2010 to 2015.

This work is in line with the longer-term objectives we set out in our 25-year plan, *Taking care of water*, published in December 2007. In some areas, however, we have had to adjust the pace of our plans due to the balance of priorities since agreed with Ofwat, and the effects of the current economic downturn.

4.2.2. Water Resources Management Plan

Also every five years, water companies in England and Wales are required to produce a Water Resource Management Plan that sets out how they aim to meet predicted demand for water over a 25-year period.

- The plan sets out how water companies aim to meet predicted demand for water over the next 25 years, ensuring sufficient water supplies are available to meet customers' needs.



- In May 2008 we published our draft plan for the period 2010 to 2035. Following a 16-week public consultation on our draft plan, we published a revised draft plan in September 2009.
- The plan consists of several elements, including:
 - a 25-year demand forecast describing how much water customers will need in the future, considering factors such as climate change and population growth;
 - a 25-year supply forecast describing how much water is available for use now and how this may change in the future, considering the impacts of climate change and potential sustainability reductions;
 - an assessment of the options to manage demand, including installing water meters at customers' properties, helping customers to be more water-efficient, and reducing leakage;
 - an assessment of the options to obtain more water, such as groundwater and surface water schemes, including an environmental, social and carbon assessment of schemes.

As part of the process we also undertook a Strategic Environmental Assessment (SEA) which aimed to assess the state of the environment, consider the potential impacts of the plan on the environment and consider alternatives which may have fewer impacts.

4.2.3. Drought Plan

All water companies in England and Wales are required by the Government to produce a Drought Plan which sets out what we would do to maintain water supplies to customers in periods of drought.

We held a public consultation on our draft Drought Plan in summer 2006 and took account of the feedback we received in developing our proposals. We also considered our experiences in the drought of 2005/06, which helped inform our approach to drought management. Our revisions were made in consultation with the Environment Agency.

The Secretary of State for Environment, Food and Rural Affairs approved our Drought Plan on 4 November 2010. The plan sets out the actions we would take to maintain water supplies to customers during a period of drought. Depending upon the severity of the drought, this might include campaigns to encourage reduced consumption, hosepipe bans, enhanced leakage control and pressure reduction.



4.3. Context of Climate Change Impacts on the Business

Some climate change impacts are unavoidable because of historic greenhouse gas emissions and will lead to variations in patterns and frequencies of droughts and other extreme weather events. Because of Thames Water's intimate dependence on the natural environment the impacts of climate change will be felt throughout our business as illustrated in Figure 2.

The projected impacts of climate change in south-east England will compound an already difficult situation in an area where water resources are already stressed and the population is increasing. We therefore need to find ways of responding to this challenge in a positive and equitable way and ensure that our responses contribute to our wider aspiration of becoming a truly sustainable business.

As a business we are embracing the need for sustainable development and consider it a key element in ensuring a better quality of life, now and for generations to come. We believe, and our customers and stakeholders agree, that a twin track approach of managing the unavoidable impacts of climate change on our business ('adaptation'), combined with a systematic reduction in our greenhouse gas emissions ('mitigation'), is essential if we are to overcome the challenges that climate change represents. Our commitment is reflected in our published policies on climate change, environment, sustainable procurement and corporate responsibility.

4.4. United Kingdom Climate Projections 2009 (UKCP09) Impacts Summary

The United Kingdom Climate Projections 2009 (UKCP09) replaced the United Kingdom Climate Impacts Programme scenarios 2002 (UKCIP02) with updated projections of climate change in the UK. UKCP09 is significantly more sophisticated both in terms of the scientific methods used in their creation and in the tools and outputs available to the user. The main outputs of UKCP09 are:

- probabilistic projections of climate change over land;
- probabilistic projections of climate change over marine areas;
- projections of trends in storm surges;
- projections of sea-level rise; and
- a weather generator tool for producing synthetic meteorological time series

One of the principal features of UKCP09 is its probabilistic nature. The UKCP09 projections are assimilated from an ensemble of output from over 300 model runs of the Hadley Centre GCM (HadCM3) and a selection of IPCC GCMs. Therefore, instead of a single 'best-guess'

of the impact of climate change (as used with previous scenarios), the projections provide a range of outcomes.

As understanding of the climate system is incomplete, and the nature of the future remains inherently uncertain. The UKCP09 climate projections attempt to reflect a range of possible outcomes. More specifically the UKCP09 projections seek to manage the uncertainties in the modelling process which are associated with the following three areas:

- natural variability of the climate system;
- statistical uncertainty in the UKCP09 methodology; and
- modelling uncertainty (parameter and structural) – relating to the complexity of the climate system and the inability to model it exactly

Although the UKCP09 projections have attempted to manage the uncertainties associated with the modelling process the underlying uncertainty of the future climate change remains. Under UKCP09 central estimates, for the medium emissions future in the 2080s, the climate in the South East of England and in London is projected to be warmer wetter winters and hotter drier summers (see Table 1). More specifically in the South East of England the future climate average summer temperatures are forecast to rise by +3.9°C and precipitation to reduce by 22%. In winter we could see average temperature rises of +3.0°C coupled with an increase in precipitation of 22%. The picture is broadly the same for London. However, it can also be seen in Table 1 that there is a wide range of uncertainty in the projections.

South East of England	London
<ul style="list-style-type: none"> • Increase in winter mean temperature is +3°C within a range of 1.6°C to 4.7°C • Increase in summer mean temperature is +3.9°C within a range of 2°C to 6.4°C • Change in winter mean precipitation is +22% in a range of 4% to 50% • Change in summer mean precipitation is -22% in a range of -47% to 7% 	<ul style="list-style-type: none"> • Increase in winter mean temperature is +3°C within a range of 1.6°C to 4.7°C • Increase in summer mean temperature is +3.9°C within a range of 2°C to 6.4°C • Change in winter mean precipitation is +20% in a range of 3% to 46% • Change in summer mean precipitation is -22% in a range of -46% to 7%

Table 1: United Kingdom Climate Projections 2009, Medium Emissions Scenario for the 2080s

As a consequence of these projected changes in future climate we have identified that we will have to deliver appropriate adaptation measures in order to protect public water supplies and the environment in the future. This means working hard to ensure that we build our understanding of the implications and use it to make decisions based on sound science.

Our 25-year Strategic Direction Statement, *Taking Care of Water*, published in December 2007, identified the potential climate change impacts on our business and the actions that we believe we need to take to ensure that we mitigate and adapt effectively and responsibly. The business plan we submitted to Ofwat as part of the PR09 process directly built on the findings of *Taking Care of Water*. Three areas of focus identified through this process were: water resource planning (to protect the security of future water supplies such as rivers and groundwater), sewerage design and flood resilience.

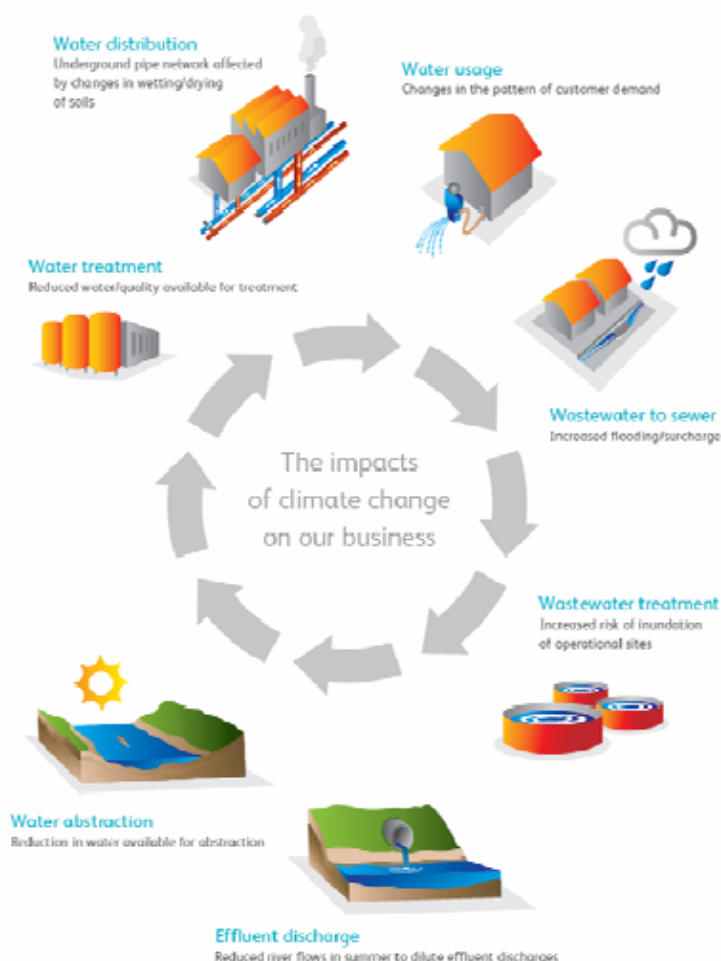


Figure 2 Climate Change Impacts on our Business

Our iterative assessment of the impacts of climate change, both qualitative and quantitative (which started in 2002 and the details of which are covered in Section 5) has identified a number of thresholds, sensitivities and incremental impacts that we need to understand and plan for. For example we have adopted a headroom approach for flood resilience at our water and wastewater sites using a 1 in 100 plus 20% storm event as the threshold to assess the potential flood risk at over 3800 sites and to identify 'at risk' sites. The information was then used to develop a prioritised programme of actions to reduce the level of risk at these sites. As part of our assessment of the need to submit an Notified Item request to Ofwat on climate change using UKCP09 we are developing a risk based assessment that assesses the sensitivity of our catchment area to the impacts of climate change.

4.5. *Engaging with stakeholders and climate change*

We take the opinions and needs of our customers and stakeholders very seriously and as part of the development of our PR09 business plan and Strategic Direction Statement (see *Taking Care of Water* on [page 127](#)) we consulted our customers and stakeholders to ensure that our plan reflected their views. We carried out stakeholder research before we started writing our 25-year strategy which sets out our priorities in the period up to 2035. We undertook two major consultations with stakeholders during the development of our PR09 business plan for the period 2010 to 2015.

Our stakeholders saw climate change as an issue of an entirely different order to other environmental issues. They regarded it as essential that we do all we can to reduce our carbon footprint. Equally, we should be planning for a climate-constrained future in which we experience drier summers and more severe weather events. Stakeholders are also keen that we plan for extremes of climate change not averages and that we keep our plans flexible. These views are compatible with our plans for 2010-15. Our approach to responding to sewerage issues is based on the need to understand issues and options and that we will need to be flexible if we are to avoid mal-adaptation (see case study '*Adapting Sewerage Networks to Climate Change*' on [page 157](#)).

In addition as part of the development of our draft Water Resources Management Plan (dWRMP) we undertook a 16-week public consultation including the Environmental Report and Strategic Environmental Assessment. In total we received 315 representations. We responded to these representations in our Statement of Response. The statement summarises the points made by the consultees and sets out in detail our consideration of the representation and the resulting changes we made to the dWRMP. In our response we clarified the method used to take uncertainty with reference to climate change into account. The WRMP was also subject to the scrutiny and challenge of a Public Inquiry during the summer of 2010. For further information see Section 8 Uncertainties and Assumptions of this



report and section B5 of our Final Business Plan
(<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

4.6. Section Summary

We are the UK's largest water and wastewater services company serving London and the Thames Valley. In the year ending March 2010 we had a turnover of £1,624 million.

Our Vision is that if our customers had a choice, they would choose Thames Water.

Our Mission is to provide the best-in-class water and sewerage service which is profitable, sustainable and acts in the long-term interests of both our customers and the wider community.

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The projected impacts of climate change in south-east England will compound an already difficult situation in an area where water resources are already stressed and the population is increasing. We therefore need to find ways of responding to this challenge in a positive and equitable way and ensure that our responses contribute to our wider aspiration of becoming a truly sustainable business.

Under UKCP09 central estimates, for the medium emissions future in the 2080s the climate in the South East of England and in London is projected to be warmer wetter winters and hotter drier summers (see Table 1). More specifically in the South East of England the future climate average summer temperatures are predicted to rise by +3.9°C and precipitation to reduce by 22%. In winter we could see average temperature rises of +3.0°C coupled with an increase in precipitation of 22%. The picture is broadly the same for London. However, it can also be seen in Table 1 that there is a wide range of uncertainty in the projections.

As a consequence of these projected changes in future climate we have identified that we will have to deliver appropriate adaptation measures in order to protect public water supplies and the environment in the future. This means working hard to ensure that we build our understanding of the implications and use it to make decisions based on sound science.



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We take the opinions and needs of our customers and stakeholders very seriously and as part of the development of our PR09 business plan and Strategic Direction Statement (see *Taking Care of Water* on [page 127](#)) we consulted our customers and stakeholders to ensure that our plan reflected their views. We carried out stakeholder research before we started writing our 25-year strategy which sets out our priorities in the period up to 2035. We undertook two major consultations with stakeholders during the development of our PR09 business plan for the period 2010 to 2015.

In addition as part of the development of our draft Water Resources Management Plan (dWRMP) we undertook a 16-week public consultation including the Environmental Report and Strategic Environmental Assessment.

5. Approach

In this section we describe in detail the evidence, methods and expertise we have developed and used to evaluate climate change impacts since 1995. In the second part of this section we explain how we have attempted to quantify, estimate or characterise the impact and likelihood of climate change risks occurring. We also explain how we evaluated the costs and benefits of proposed adaptation options. The concluding part of this section explains how we have been working with other stakeholders to improve our understanding of climate change.

Our approach to climate change has not been developed as a response to the Adaptation Reporting Power Direction. We have included elements of climate change impact in our business planning since as long ago as 1997 (see Section 5.1). Although our approach is aligned with the five yearly planning cycles of our regulators we have taken a longer 25 year view of climate change impacts as part of our planning for PR09 (see Section 5.1).

Lord Krebs (the Chairman of the Climate Change Committee) has highlighted that it is important to recognise that even well adapted societies (and this could read companies) will suffer some disruption from climate change as a consequence of natural variability. Our approach to understanding and managing the impacts of climate change is to try and ensure that these impacts are minimised as far as possible.

5.1. *Understanding and responding to climate change*

Figure 3 illustrates how Thames Water has been active in the climate change area since the mid 1990s when we started undertaking research into climate change impacts on water resources with UKWIR (see case study '*Climate Change Research 1997-2010*' on [page 131](#)). From 1997 we have incorporated climate change impacts into our water resource planning processes.

We developed an "expert" adaptive capacity and understanding of issues and implications for the business as long ago as 2000. Then between 2003 and 2004 we undertook a more detailed assessment (including a qualitative risk assessment) of potential strategic impacts and implications of climate change on our activities. This work looked at a wide range of possible impacts and involved the collection of qualitative and quantitative information.

We established five questions that we needed to address if we were to understand and respond effectively to the impacts of climate change:

1. what is climate change and how will it manifest itself?

2. what are the potential business impacts/issues associated with it for us?
3. how significant are these impacts?
4. what is the business already doing that will minimise the impacts?
5. how can we manage this challenge in a strategic way?

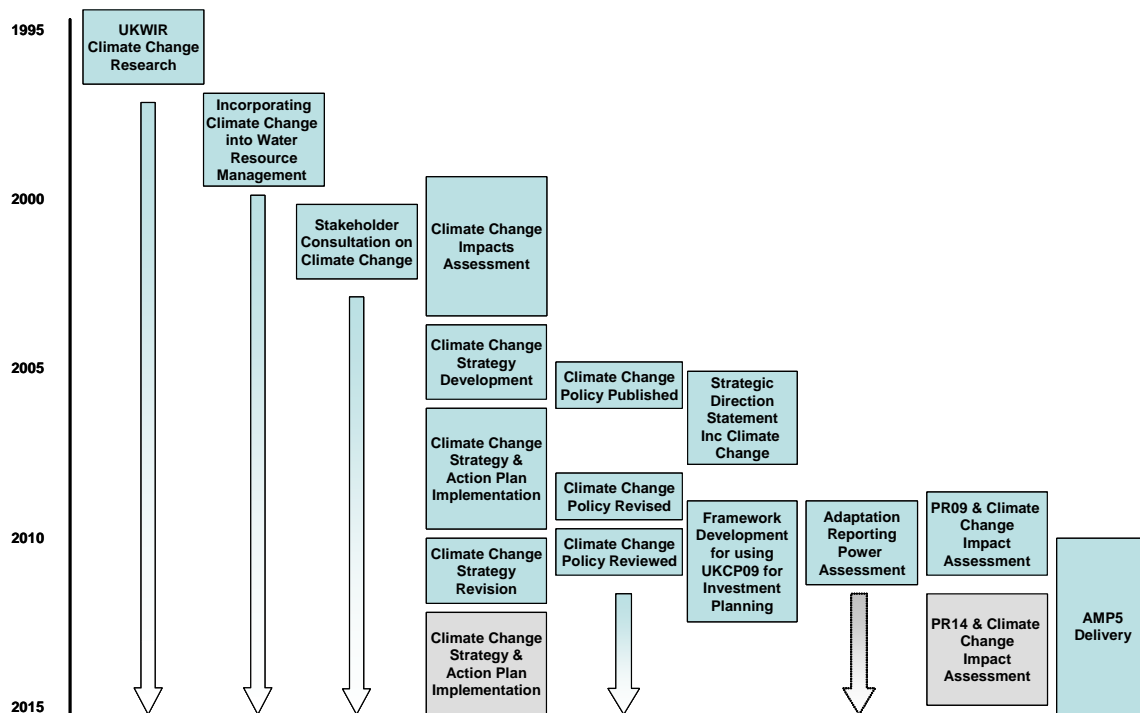


Figure 3: Thames Waters Climate Change Impact Assessments 1995 to 2015

The first part of the study involved a qualitative assessment of data relating to a wide range of possible impacts on the business as a consequence of climate change including: Political, Economic, Social, Technological, Cultural, Organisational, International, Legal, Environmental and Demographic. The qualitative data was collected by a number of mechanisms including discussions with academics/experts, informal cross industry discussions, brainstorming and workshops.

The analysis and interpretation of this data demonstrated that climate change was a genuine issue for Thames Water. We then verified our findings for validity and consistency both inside the business and externally. This was achieved through the development of a structured questionnaire which was completed by key Thames Water staff, key employees of other water companies and a range of third party stakeholders including academics, consultants, regulators and local authorities. By including the views of these different groups we were able to triangulate opinions. The key findings of the study were:

- more explicit guidance is needed from Government and Regulators;

- new and existing legislation/regulation must be aligned to this issue; and
- concern that new legislation may lead to mal-adaptation e.g. Water Framework Directive;
- political and regulatory cycles are out of alignment which thereby reduces companies ability to secure funding to adapt;
- infrastructure needs to be climate change-proofed;
- infrastructure likely to become increasingly unsuitable for dealing with future climate projections e.g. sewerage and flood resilience;
- there will be insufficient water resources if additional adaptation measures not delivered;
- lack of internal strategy will prevent effective adaptation;
- lack of certainty about what climate future we need to adapt to and lack of assigned probabilities to climate projections making planning difficult;
- lack of resources exist to deliver adaptation both internally and externally; and
- lack of political will exists to deliver adaptation

These findings have informed the development of our strategy to adapt to the impacts of climate change. There are many synergies with progress at the national level although some critical issues remain (see Section 9 - Barriers to Adaptation and Interdependencies).

In April 2005 an overview of the issue was presented to the Thames Water Board out of which the challenge to develop a Climate Change Policy was set. In June 2005 a cross business workshop was held at which the findings of the impacts assessment were challenged and verified internally to identify any omissions and develop high level consensus of the issues, impacts and way forward for the business.

Our Climate Change Policy was agreed in January 2006. Following this, in March, the Board agreed the key high level issues and impacts of climate change that the business should investigate further. During September 2006 a 'Climate Change and Carbon Management Strategy - The Way Forward!' cross business workshop was held to establish a reference to the Climate Change and Carbon Management Strategy and create a framework to allow the business to respond to the impacts of climate change, carbon management and sustainability. The outputs from this workshop underpinned the development of Thames Water's first Climate Change and Carbon Management Strategy. The strategy was delivered in November 2007 and adopted in April 2008. In addition to ensure that the strategy was delivered an action plan was also developed and agreed with delivery dates and clearly identified ownership and accountabilities.



April 2007 to June 2007 – Our draft Strategic Direction Statement was sent out to public consultation including customers, regulators and NGOs. The climate change position was developed directly from the draft Climate Change and Carbon Management Strategy. In December 2007 we delivered our final Strategic Direction Statement to Ofwat which outlined our 25 year forward look at the business including climate change adaptation and mitigation.

The 2007 assessment was derived from our 2004 analysis of business impacts of climate change. This was based on expert judgement but challenged and validated internally (through workshops) and externally by industry experts, regulators, academics and other stakeholders. Learning from this assessment was directly fed into the development of the WaterUK planning tool to support a common approach to assessing adaptation risks related to asset management planning by Montgomery Watson Haza. The framework was used to validate and support the approach adopted by Thames Water for PR09. As part of the production of our response to the Adaptation Reporting Power we have used this revised semi-quantitative risk assessment framework incorporating expert judgement to review our analysis of climate change risks to our business (see case study '*Expert Judgement Semi-Quantitative Risk Assessment*' on [page 139](#)).

Our assessment of climate change has not been undertaken in isolation and we explicitly included it in our wider sustainability assessment during the development of both our draft and final Business Plans for the periodic review process (for more detail see the following Section 7 - Actions Proposed to Address Risks and case study '*Climate Change Adaptation and Sustainability*' on [page 145](#)).

A recent report for Defra by Price Waterhouse Coopers, Adapting to climate change in the infrastructure sectors, published in November 2010 supported our understanding of the issues and implications of climate change on our business.

5.2. Business Risk Assessment - Managing Key Risks and Uncertainties

In the following sections we discuss our approach to risk both in terms of general business risk but also specific climate change risk. The areas covered include: Business Risk Assessment, Asset Operating Risk, Water and Wastewater Risk Framework, Operational Risk Assessment and Flood Risk Planning/Screening/Analysis/Management.

The risk to our business associated with climate change is only one of many and must not be considered in isolation. There is a danger that if the focus is solely on climate change then perhaps other nearer term risks could be overlooked.



We are committed to high standards of corporate governance in the management of key risks to the appointed business (for more information see section B1.3 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>)). The following sections discuss our approach to the management of key risks under the following headings:

- investment Planning and the Development of our Business Plan for PR09;
- developing Water and Wastewater Risk Frameworks;
- bottom Up Operational Risk Assessment;
- our Risk Management Procedures;
- major projects;
- cost Benefit Analysis Overview;
- climate Change Impacts and Flooding;
- framework to Assess the Risk of Flooding at Critical Assets;
- climate Change Impacts on Water Resources;
- changes in Rainfall Intensity and Impacts on the Sewerage Network;
- headroom Analysis – Accommodating Climate Change;
- security and Emergency Risk Management;
- the Wider Context - Developing our PR09 Business Plan; and
- working in Partnership to Understand Climate Change

5.2.1. Investment Planning and the Development of our Business Plan for PR09

During AMP4, we invested significantly to improve our understanding of the condition and reliability of our assets. We have transformed our asset management planning capability through the development of our processes, systems and people, and built on the business-as-usual operational risk management approach that was successfully introduced in AMP3. Asset management planning is fully integrated into the company, our wider strategic direction and Board objectives. We therefore understand our operating risks better than ever.

We have actively engaged with UKWIR as part of the development of their Asset Management Planning Assessment Process (AMPAP) and we have used the tool internally to identify some of our strengths and weaknesses in relation to Asset Management Planning.

The industry-developed Common Framework for Capital Maintenance Planning (CFCMP) underpinned our approach to the development of all asset cases for PR09. We have fully incorporated the CFCMP into our asset planning through the development of a transparent and well-documented internal process that we use across the company to rigorously assess all capital maintenance cases.



Our approach is based on the following steps, which are consistent with the CFCMP:

- past and current performance assessment;
- predicted future performance;
- risk analysis and need scoring;
- solution development; and
- programme development

Further detail of the alignment between the CFCMP and our internal processes is provided in Part B3 of our final Business Plan

(<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

We have developed our Business Plan around a risk methodology for all four of our investment categories (Base, Quality, Enhanced Levels of Service and Growth). All solutions in our final Business Plan have been assessed against a standard risk framework to identify the risk to customers with and without investment. This risk framework is centred on the key measures of customer service. Customer valuations of service have been derived from stated preference surveys and attached to the risks to create benefits. In this way we have built a plan that addresses the most significant risks to our customer service. Risk management is therefore embedded in our plan selection.

Risk forecasts are made for future years using calibrated models. This approach enables us to understand and compare the risk profile of all our assets and to be able to assess the investment needed to manage this risk in the future. Our cost benefit analysis framework is integrated into our Asset Planning System and solution selection criteria. It calculates the whole life cost over a 40-year planning period, incorporating costs associated with maintaining assets, carbon costs and traffic disruption costs.

5.2.2. Developing Water and Wastewater Risk Frameworks

Under the Common Framework and AMPAP, we carried out risk assessments on our investment options. Our Water and Wastewater Risk Framework measures align to service to customers, the environment, and some of our business and asset stewardship drivers. On the water side, measures include; interruptions to supply, low pressure, treated water quality, pollution incidents, nuisance and road traffic disruption. On the wastewater side, measures include; internal and external flooding, flow and effluent consents, sludge disposal and odour. Many of the measures originate from the operational risk management methodology that we developed in AMP3. For further information on these risk frameworks, and the approaches



for assessing current and future needs by asset type, please refer to sections B3 and C8 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

For each measure (and each severity band) we assign a valuation that has been derived from customer valuations through stated preference surveys or from business knowledge. These valuations are held in our investment management system (IMS) and allow us to value the expected benefits of the interventions stored in our Asset Planning System (APS). Our assessment of frequency of asset failure projections into the future and the probability of failure leading to impact are made using calibrated models, although for non-infrastructure assets, we sometimes need to rely on expert judgements, depending on the availability of asset failure data.

5.2.3. Our Risk Management Procedures

We have in place, and will continue to maintain, an integrated Business Risk Management (IBRM) process. Through this process we identify, assess and manage our corporate, strategic, operational and project-derived risk exposure. The IBRM process provides a generic framework for the assessment, labelling, recording and reporting of risks and is supported by robust risk management processes within all business areas. The IBRM process supports:

- risk-informed business planning;
- enhanced risk informed decision making at all levels of the business;
- delivery of all regulatory and legal obligations;
- satisfaction of corporate governance requirements; and
- protection of shareholder value and other stakeholder interests

Accordingly it has three principal aims:

- **Corporate Risk Portfolio:** To provide visibility of the corporate risk portfolio the business carries;
- **Governance:** To ensure compliance with all relevant Corporate Governance requirements; and
- **Assurance:** The ability to demonstrate adequate corporate and operational risk management arrangements to all key stakeholders including shareholders

Risk registers are maintained for all front line, and supporting business units, each of which nominates a risk representative responsible for analysing and reporting risks within their organisational unit. This provides a complete inventory of risks to the business, and records



each risk along with its respective Risk Owner, Response Plan, Completion Date and Response Plan Owner.

Business unit line management and the associated Executive Management Team (EMT) member are responsible for managing risks and ensuring effective Response Plans are in place. Progress against Response Plans is reviewed and monitored based on significance and communicated to the Risk Review Committee (RRC).

There is a requirement that all risks are quantified, and that they are evaluated and categorised in accordance with prescribed methodologies. On a quarterly basis each business area identifies its material risks using risk thresholds linked to corporate requirements and the respective objectives and Key Performance Indicators in that business area. Business units escalate these risks via the relevant EMT member for inclusion at the RRC.

The RRC is chaired by the Head of Internal Audit and attended by Senior Management Risk Advisors from each business area, meets quarterly to assess the escalated business risk portfolios from across TWUL with the objective of establishing the business risk portfolio for escalation to the EMT and Audit and Risk Review Committee (ARRC).

5.2.4. Major Projects

We may be required to deliver some exceptionally large single engineering projects in the coming decade definitely including the Tideway project (comprising the Lee Tunnel & Beckton Sewage Treatment Works Extensions) and possibly the Thames Tunnel and the Upper Thames Reservoir in the 2020s.

- **The Tideway Project:** The Lee Tunnel, Thames Tunnel, and the Beckton Sewage Treatment Works extensions are driven primarily by statutory obligations, although with additional treatment capacity approaching 1 million cubic metres per day, the Beckton STW extensions will also accommodate growth in the Beckton sewerage catchment. Construction is underway for both the Beckton STW and Lee tunnel, with completion planned in 2015. Consultation on the route of the Thames Tunnel is ongoing, with a construction start planned for 2013. The eventual storage capacity is expected to be in excess of 1.1 million cubic metres and it is proposed that this will be emptied for treatment at Beckton in 48 hours, with a pumped lift from nearly 75 metres deep. The Environment Agency has been involved throughout the development of these projects.

- **The Upper Thames Reservoir¹**: This is a large infrastructure project consisting of the construction of a major new pumped storage reservoir in the upper Thames catchment area, near Abingdon, Oxfordshire. The reservoir is a key component of our preferred programme within our Water Resources Management Plan (WRMP). The reservoir is currently our preferred option for maintaining security of supply in the London Water Resource Zone from 2026/27, and the Swindon/Oxfordshire Water Resource Zones from 2024/2025.

The scale and complexity of these projects entails a high degree of uncertainty and requires a rigorous approach to risk management. We have applied a structured risk management process to the development of the projects in line with HM Treasury's Green Book guidance where we have taken action to adjust for optimism bias.

5.2.5. Cost Benefit Analysis Overview

The introduction of a requirement for cost benefit analysis (CBA) for PR09 was a major new challenge for the whole of the Water Industry. The approach brings greater transparency, regarding the improvements customers will see for their money, through the up front consideration of the benefits of investment and is critical to the achievement of our vision to become the company our customers would choose for their water and wastewater services.

Cost benefit analysis was one of the principal tools used in the development of our plan. For this periodic review we adopted a new analytical framework, our investment management system (IMS). This tool allows us to select projects and build programmes on an economically optimal basis (i.e. to maximise net benefits). IMS is now a critical tool in our decision-making processes and positions us securely for undertaking CBA routinely in the future.

Our analytical framework enables us to use the industry best practice decision making framework for Asset Management as described in the British Standard PAS55. Throughout our programme, analysis enabled us to understand and balance the three asset management factors of Cost, Risk and Performance. Whole life costing is at the heart of the cost benefit analysis. Using IMS and the initial risk assessment of our assets, together with the results of our customer preference surveys, statutory and regulatory requirements and our strategic aspirations, as outlined in our Strategic Direction Statement, we were able to adopt a balanced approach to cost, risk and performance in the development of our plan.

¹ We are still awaiting the Secretary of State's decision on the suitability of our WRMP following a Public Inquiry in 2010 and therefore this remain a preferred plan rather than the final plan.



We tested our entire investment programme to ensure that, wherever possible, benefits to customers exceeded the costs except where quantified cost benefit was an inappropriate tool. In line with Ofwat guidance, we focussed our cost benefit activity on those areas where customers have indicated strong support for enhancements. In these areas we have used cost benefit analysis to determine the appropriate level of investment. In other service areas we have used a combination of some or all of, cost benefit analysis, cost effectiveness analysis and historic evidence from which to derive our plans.

Our approach has been peer reviewed by Professor Ken Willis of Newcastle University. His conclusion was that “TW has been very successful in producing a rational, realistic and robust methodology to optimise economic investment.” We have taken careful consideration of guidance documents available and are satisfied that our methodology is aligned with the Green Book, the UKWIR guidance and the Ofwat guidance. The framework and processes that we have established are also consistent with the principles of the British Standard for Asset Management, PAS55.

5.2.6. Cost Benefit Analysis Principles and Application

We have developed a framework for the identification and assessment of whole life costs and benefits, to the company as well as to customers. The key elements of this framework are shown in Table 2 below.

Costs Block	Benefits Block
Capex (£)	Costs avoided (repairing asset failure) (£)
Incremental Opex (£/yr)	Costs avoided (service failure) (£)
Embodied Carbon (tonnes)	- GSS payments
Operational Carbon Impact (tonnes)	- Fines
Project Traffic Disruption	- Clean up costs
Environmental and Social Cost (£)	- Legal costs
	Willingness to Pay (£)
	Avoided Environmental and Social Costs (£)

Table 2: Framework for Cost Benefit Analysis Application

CBA is embedded in our investment decision making processes and additional details of the analyses undertaken are given in each of the sections B3-B6 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

5.2.7. Cost Benefit Analysis Application

Figure 4, below, represents a high level view of the process used to undertake CBA. Every investment need identified through our detailed risk assessment process is entered into our corporate asset planning system (APS). This stores information on the location of the need with a full description. Solutions to mitigate the needs identified are also entered into APS. Solutions are costed using our corporate unit costing system or more detailed costs applied where these are available. APS also stores all the elements of costs and benefits. The benefits assessment is undertaken through a process of risk scoring, documented in APS, then valuations are applied within the system.

The calculations of whole life cost and whole life benefit are undertaken automatically within our Investment Management System (IMS). IMS takes data from APS, and for each service area, selects projects with positive net benefits, building economically optimal investment programmes. Our sewer flooding alleviation and odour reduction programmes have been derived directly from use of IMS.

The CBA is undertaken by each of the work streams in developing their investment programmes. In order to ensure consistency of application the central IMS team reviewed each of the cases and identified any inconsistencies of approach. This review also identified any potential for double counting.

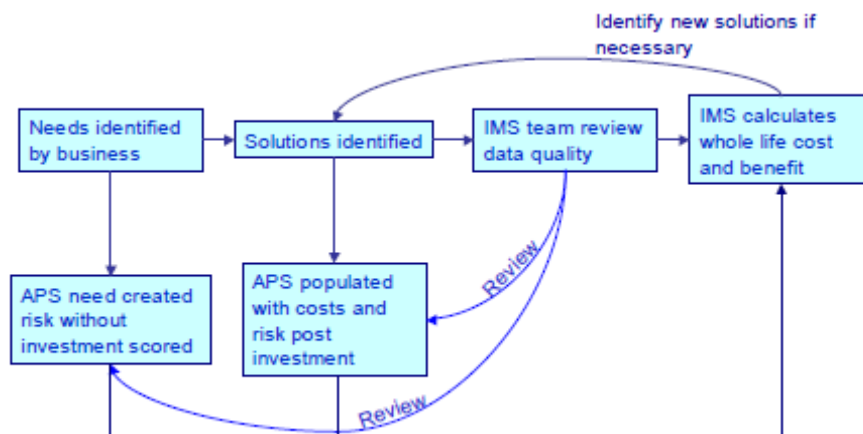


Figure 4: Cost Benefit Analysis Business Process

5.2.8. Climate Change impacts and flooding

The exceptional weather conditions experienced during the early summer months of 2007 gave rise to widespread and serious levels of flooding in many parts of the UK. The most significant rainfall event was recorded on 20 July over the south Midlands, where many weather stations recorded their highest levels of daily rainfall since the England and Wales precipitation records began in 1766. The direct effect of flooding was unsurprisingly devastating for many people and it also caused major disruption to power supplies and water services.

On the wastewater side of our business, this affected services at more than 50 sewage treatment works (STW) and over 100 sewage pumping stations (SPS). The combination of network inundation, power loss and mechanical damage resulted in untreated sewage being discharged into the environment from a number of these sites.

On the water side it affected services from Grimsbury WTW supplying Banbury and surrounding areas, where the flood reached a depth of up to five feet as shown in Figure 5. However, because we were able to re-zone the supply area through a series of valve operations, no customer suffered a loss in supply but some customers experienced changes in pressure as a consequence of the rezoning. This functionality had only recently been created in anticipation of such instances. The treatment works was completely out of action for over three months because of the flooding incident.



Figure 5: Grimsbury Water Treatment Works Flooded

The Pitt Review, commissioned by the Government following this event, made a number of recommendations with respect to protecting strategic installations from future flooding. Essentially, the requirement is to keep key sites operational by protection, improved monitoring, IT and communication systems. Enhanced emergency response preparation was also required.

5.2.9. Framework to assess the risk of flooding at critical assets

In order to help water companies to address these issues, Halcrow, on behalf of Ofwat, released a framework to assess the risk of flooding at critical assets and identify cost-beneficial resilience options. This is known as the Service Risk Framework (SRF) for flood hazards and has been referred to as 'Ofwat's' approach within this flooding resilience text. Our flooding resilience programme is based on Ofwat's 3-staged approach, being planning methodology, best value solution and cost benefit analysis, and hence our AMP5 investment focuses on our most critical assets.

Because it is almost always impractical to move water and wastewater assets there are two options available to water companies either:

- develop responses which prevent the site being inundated; or
- allow flooding to occur but minimise the impact of the flood and allowing the site to become operational again as quickly as possible after the flooding subsides

If a STW is inundated during an extreme event, the result, without flood resilience or resistance measures will be a loss of treatment capability. This will result in a pollution incident. The impact of this pollution incident would be hard to determine, set against the highly polluted flood waters from overland run off. Because of the open connection of the sewer to a wastewater treatment works it is not feasible to resist flood water. Therefore our management strategy is to recover the work's treatment capability as soon as floodwater subsides i.e. to make it as resilient as possible. The proposals included in our final Business Plan are intended to:

- avoid pollution incidents and consent failures for a post-flooding event;
- prevent loss of function of critical storm pumping stations caused by inundation from flood flows; and
- avoid damage to our equipment resulting in uninsured losses

In addition to our work to identify sites at risk of flooding, we have also reviewed critical pumping stations that drain large areas of surface water or combined flows. Failure of these pumping stations would exacerbate flooding in the networks, as happened in Hull in 2007. The investment need on these assets is to ensure they can continue pumping flow when surrounding areas are inundated. We have increased our Capital Maintenance expenditure on these critical SPS sites to reduce the risk of exacerbating flooding due to asset failure.

Losing any part of a WTW due to flooding, would result in an immediate loss of production of water because of potential contamination issues and loss of water pressure within the network. De-contamination and re-pressurisation takes a significant amount of time as was evident when Mythe WTW, in Gloucestershire, flooded in July 2007 where thousands of customers went without mains water for over 16 days.

Although the rainfall causing this incident was unprecedented, we do not believe that a recovery period of this duration, following a flood event, is acceptable for our customers. The Customer Preference Surveys, undertaken for the PR09 investment planning (January 2008), shows our customers place great value on avoiding interruptions to supply. It is therefore essential we take appropriate action to maintain supply. Flood resistance measures (i.e. keeping flood water out) are therefore required to maintain water supply.

In addition to our requirement to manage interruptions to supply (DG3) we include in our objectives the need to maintain supply to customers to manage risks to public health, the interests of our business e.g. insurance claims and the environment e.g. from chemical contamination and preventable loss or damage to critical services.

In our assessment of risk we have taken into account local flood protection. We have assumed that this level of protection will continue through the Thames Estuary 2100 project, therefore the proposed AMP5 mitigation measures reflect additional requirements for flood protection over and above those in place or planned locally.

5.2.10. Flood risk assessment and planning for waste water sites

There are three stages to Ofwat's SRF, which we have followed to develop cost beneficial solutions at strategically important assets. In the following three sections we have set out our methodology in line with these stages:

(1) Risk Screening

We have carried out flood risk modelling on all of our wastewater assets to identify flood risk during a 1:100 +20% storm event as required by the framework. The level of risk was first assessed using two modelling approaches:

1. Fluvial/Tidal flood risk: The EA flood mapping zones (graded zones 1 – 3, with zone 1 being a low probability and zone 3 being at high risk of flooding) were used to estimate the level of flooding risk at all sites. This method was extrapolated for small watercourses. Results focused on the impact of zone 3 (a 1:100 year flooding risk)
2. Pluvial flood risk: Our catchment area was divided into 5km squares and a 1:1000 year storm modelled. The results produced a good representation of the flow path but an overestimation of the depth. This was calibrated to give a predicted 1:100 +20% flash flood depth at all of our sites

A large number of sites were found to have a low level (or risk) of flooding. These assets have been identified as being at limited risk, due to natural or man-made drainage being able to cope with inundation, and were excluded from further analysis. The sites modelled with a higher predicted level of flooding were then carried forward for risk analysis.

(2) Risk Analysis

After screening out low risk sites, we produced a priority list for wastewater assets based on size (Population Equivalent (PE) within, or greater, than Ofwat's Asset Inventory band 4 ranking) for STW and energy use (kWh) for pumping stations.

Flood maps were produced to visualise the flood hazards on each prioritised site and modelled flood depths were manually checked site by site to remove abnormalities from modelling.



Our Operations staff then reviewed the list to validate our approach and ensure all sites with a history of flooding were included. Where other flooding issues were identified these sites were included in the PR09 investment programme.

(3) Risk Management

Preventing floodwater entering a sewage treatment works is not practical in most locations because many sites are connected to gravity fed sewer networks. Disconnecting a works by flood gates (assets) from both the river and network could exacerbate the impact of flooding in the upstream and possibly urban parts of the catchment. There is also a risk of works being flooded by high river levels.

Therefore, we have applied flood resilience solutions including raising of equipment, building resilience and partly local bunding at the highest risk wastewater assets. These solutions have been assessed for practicality during the technical site surveys. We have estimated the cost of each feasible solution on each site to determine the most cost-effective solution. It is also critical that sewage pumping stations are operational during heavy storms in order to maximise the flow pumped away from sensitive areas. Urbanised areas are particularly susceptible and rely almost entirely on piped drainage systems (including public sewers) to avoid surface flooding.

Not all of our prioritised proposals have been funded in AMP5 by Ofwat and so we will be carrying a higher degree of exposure forward during the current AMP period (see also Section 9 - Barriers to Adaptation and Interdependencies). We hope to make the investment case to Ofwat in the next Periodic Review which secures the funding required to protect this critical infrastructure.

5.2.11. Climate Change impacts and water resources

Some climate change impacts are unavoidable because of past carbon emissions. This will lead to variations in patterns and frequencies of droughts, and other extreme weather events (see Table 1: United Kingdom Climate Projections 2009, Medium Emissions Scenario for the 2080s for details).

The impacts of climate change will be felt throughout our business, as shown in Figure 2. In terms of supply and demand it is the potential impact on water usage and abstraction that is of particular concern. For example, reduced or extreme variation in annual rainfall rates may mean that the yields from river or groundwater sources could be reduced, and household water use could increase through increased garden watering.

To calculate the supply-side impacts for our Final Business Plan, the Company adopted the UKWIR06 methodology (which it helped develop through UKWIR) as recommended in the EA's WRP. Factors from six global climate models have been used to produce rainfall and evaporation data to feed into our Water Resources Management System (WARMS). In addition the impacts of climate change on groundwater sources have been reviewed following the new methodology.

Sensitivity analysis assessing the impact on Deployable Output (DO)² following the new methodology using the 'Dry' and 'Wet' climate change scenarios gives a range of change in London by 2025/26 from -487 Ml/d (Dry scenario) to +195 Ml/d (Wet scenario) with a 'Mid' impact of -99 Ml/d. As set out in the Environment Agency guidelines, the 'Mid' scenario is applied as a reduction in DO as set out in Table 3, the uncertainty around this projection is handled in Headroom.

WRZ	Reduction in Dry Year Annual Average DO due to Climate Change (Ml/d)					
	2009/10	2014/15	2019/20	2024/25	2029/30	2034/35
London	14.1	49.5	84.9	97.0	106.9	116.8
Thames Valley	1.1	3.8	6.5	7.3	8.2	8.8
Total	15.2	53.3	91.4	104.3	115.3	125.6

Table 3: Climate Change Impact on Deployable Output

5.2.12. Headroom Analysis – Accommodating Climate Change

Almost all the components of supply and demand together with their associated planning assumptions including climate change are subject to uncertainty. Therefore, how uncertainty is allowed for is of fundamental importance in supply demand planning. The approach taken in developing our final Business Plan and Water Resource Management Plan followed the latest water industry methodology, which uses a margin of safety termed 'Target Headroom' (TH) as a buffer between supply and demand. This covered in more detail in Uncertainties and Assumptions below and in Section B5 Maintaining the Supply/Demand Balance of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

² Deployable output is defined as: "the constant rate of supply that can be maintained from the water resources system except during periods of restriction within the following constraints: given levels of service; the historic period for which data are available or could be derived; supply without storage entering the emergency storage zone; supply within the defining physical capabilities of the existing system adopted for the simulation; source operation in accordance with the licence, or, for specified scenarios, a drought order or permit."

5.2.13. Changes in Rainfall Intensity and impacts on the sewerage network

Climate change is already acknowledged to be affecting weather patterns, and is generally expected to increase storm intensity. Our analysis using UKCIP02 climate change scenarios indicated that parts of our region in the west of the Thames Valley may experience increased storm intensity due to climate change, but London and the east may have less frequent and intense storms (a 45% increase to a 20% decrease from today by 2080).

One of the principal impacts of climate change will be on sewer infrastructure. Until more accurate probabilistic data is available to allow us to model the effect of climate change on our wastewater assets we cannot promote schemes or put a cost on the impact effectively. As a consequence we did not include any specific funding under this driver apart from the change in our design standards for flood alleviation to a level of 1 in 30 years (See section B5 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>)).

The changes in climate may have a very significant impact on wastewater networks and it is likely that our main long term focus for adapting to climate change will be to limit surface flows to our network where possible and to install controls to maximise the attenuation of flows in our system. We believe that simply delivering “more of the same” i.e. building greater capacity into pipes and tanks will not be either sustainable or feasible and that we need to develop new options that we can deliver from AMP6 onwards. We therefore included in our plan continuous monitoring of critical points in the network which is supported by IT and Supervisory Control and Data Acquisition (SCADA) investment covered in section B3 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>). This will enable us to understand flow trend changes and move towards active network management over the next 10 years. We consider that this is a pragmatic approach for taking climate change into account for wastewater networks.

We recognise that the impact of climate change for water supply demand is regional, rather than local, and also is based on longer term trends. This explains the difference in the approach to climate change adaptation responses between water and wastewater.

5.2.14. The wider context - developing our PR09 Business Plan

Whilst we seek to minimise the impacts of climate change on our business it is also essential that we strive to achieve the right balance for consumers and the environment if we are to become a truly sustainable company. Figure 6 summarises the iterative and challenging



approach we used to develop our final Business Plan. It describes the eight broad phases of development that we have gone through to ensure that our Plan delivers customers' priorities, meets statutory requirements, delivers environmental improvements, and provides services that deliver value for money at a price customers can afford. It also explicitly takes the impacts of climate change into account. For more information please refer to section B1.4 of our final Business Plan.

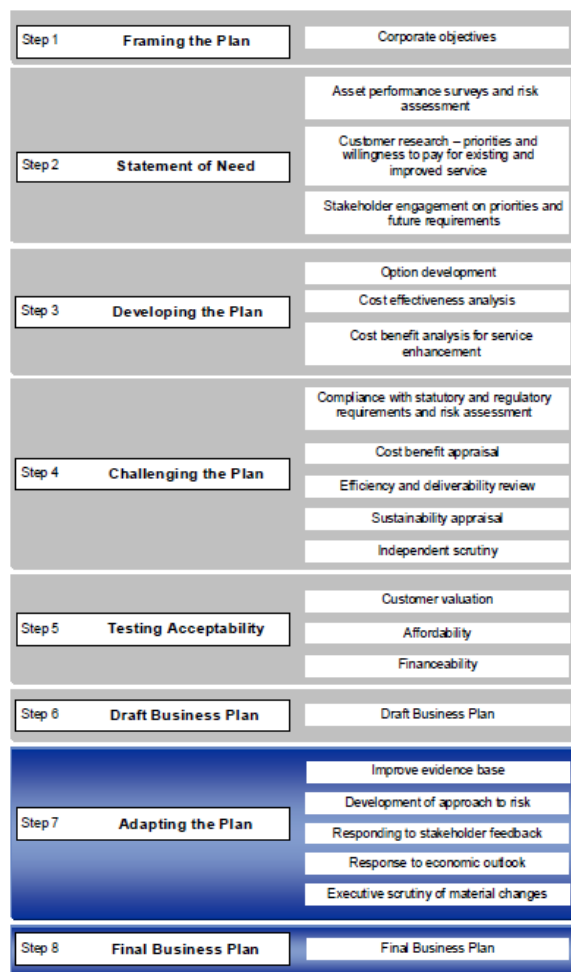


Figure 6: Achieving the Right Balance for Consumers and the Environment

5.2.15. Working with others to understand climate change

It is neither possible nor sensible for an organisation to understand the impacts of climate change and develop robust responses in isolation. This is why we have been undertaking and funding collaborative research on climate change to help us better understand the impacts and to develop effective adaptive responses. Similarly it is important to share understanding and to combine our knowledge to develop not only effective but sustainable solutions.



5.2.16. Climate Change Research 1997 to 2010

Thames Water have contributed funding, expertise and helped to lead and steer the research on climate change through a number of different channels. We have been very active in leading the climate change work undertaken through United Kingdom Water Industry Research (UKWIR) and Water UK (see case study Climate Change Research 1997 to 2010 for more detail on [page 131](#)).

We have also been actively working with, and contributing funding to, the work of UKCIP, the London Climate Change Partnership, Climate Southeast and the Three Regions Climate Change Partnership. In addition we have provided expert advisory support to Tyndall Centre and Defra lead projects. We have helped ensure that narrow and unsubstantiated perceptions are challenged and robust outputs are delivered.

The research undertaken to which we have contributed since 1997 has covered a wide variety of critical areas including General Impacts, Droughts, Water Availability, Water Quality, Use of Low Quality Water, Stormwaters, Regional Impacts, Transport, Mitigation Measures and Carbon Accounting.

5.2.17. Security and emergency risk management

As a company we face a range of security and emergency risks which could affect the achievement of our objective of providing essential water and sewerage services.

Some of our assets form part of the critical national infrastructure and, as such, we face security risks associated with the threat that our operation may be used by a third party to cause disruption. We face additional security threats that may become manifest in commercial and reputational risks at the corporate level such as fraud, organised crime, computer hacking, data loss and resource shortages. In addition to the man-made threats, our operation is vulnerable to natural hazards such as severe weather, flooding and climate change that may manifest in emergency risks. Likewise, some of our assets are more vulnerable due to an ageing infrastructure and abrupt failure may require an emergency response.

All of the above have the capacity to stress our organisation and threaten the achievement of our business objectives and a range of risk control measures are required to reduce the likelihood and impact of security and emergency risks that would have a negative impact on our business, customers or stakeholders.



The Thames Water Security and Emergency Risk Management Policy and Process is designed to ensure that the risk control measures associated with risks either caused by malicious intent or requiring emergency response are:

- proportionate to the risk;
- address both the national and corporate interests;
- are business enablers rather than business blockers; and
- use the full raft of risk management measures ranging from defensive risk management strategies such as physical hardening to proactive corporate resilience strategies such as the ability to absorb local failure by re-routing through other parts of the system

Contingency planning is related to the acute impact of existing natural hazards and the wider issues associated with civil contingencies for example the flooding experienced in 2007. As the external environment changes some risk sources transition from rare to ubiquitous including the risk of flooding associated with climatic change. The most economic treatment of a rare risk is effective disaster recovery whereas a risk that is more frequent should be accommodated within business as usual in the form of corporate resilience. Thames Water has an active programme of tracking all risk sources and targeting investment to be able to handle the risks of both today and tomorrow. Additional associated information can be found in Sections 7, 9.11 and 11.11.

Thames Water welcomes the recent publication of the UK's first National Infrastructure Plan. The setting of clear priorities at the national level will undoubtedly result in increased value for money investment and act as a crucible for future economic growth. We are also greatly appreciative of the Cabinet Office initiative to provide a framework for the coordination of security and resilience of the national infrastructure. The national infrastructure is a vast interconnected system of systems that is both the heart and the lifeblood of the nation's economy. Failure to protect this system in a coordinated manner would be a little like riding a motorbike in full leathers but forgetting to wear a crash helmet. The leathers will protect vital organs such as the heart and spleen but if the brain is damaged the body as a whole is damaged.

5.2.18. Working in Partnership

Climate change remains a key challenge for society, and we have continued to work with the Government, non-governmental organisations, academics and other businesses to combine our knowledge and develop sustainable solutions.



We have worked with, shared information/learning and funding with a wide range of organisations, including DEFRA, the Environment Agency, Ofwat, the Greater London Authority, the Tyndall Centre for Climate Change Research, Research Councils, London Climate Change Partnership, Climate Southeast and the cross regional Three Regions Climate Change Partnership and will continue to do so. As a member of the Prince of Wales's Corporate Leaders' Group on Climate Change, we are working at the highest levels within business and government to develop new, longer-term policies to tackle climate change. As part of this group we have been proactive in ensuring that the need for adaptation is highlighted, understood and promoted.

At the industry level we are an active member of the WaterUK Climate Change Forum, which is working to ensure that adaptation and mitigation work across the water industry is appropriate, sustainable and equitable.

We believe that it is important for individual organisations and sectors to share learning and understanding wherever possible or practical. This is why we are actively engaged with the organisations identified above.

Working in partnerships goes beyond simply sharing information to delivery on the ground. In the attached case study, 'Adaptation through managing water demand' on [page 161](#) we describe how we are working with a variety of partners to deliver water savings in our region including metering, retrofitting properties, educating the public and working with schools. For more information please refer to the following case studies: 'Working together and Adaptation through managing water demand' [page 161](#).

As part of commitment to working with third parties we produced a case study on adapting to climate change for UKCIP/DEFRA. This case study can be downloaded from http://www.ukcip.org.uk/images/stories/Business/BCS_ThamesWater.pdf.

5.3. Section Summary

Our approach to climate change has not been developed as a response to the Adaptation Reporting Power Direction. We have included element of climate change impacts in our business planning since as long ago as 1997 (see Section 5.1) which has included answering five key questions in order to understand and respond effectively to the impacts of climate change:

1. what is climate change and how will it manifest itself?
2. what are the potential business impacts/issues associated with it for us?
3. how significant are these impacts?
4. what is the business already doing that will minimise the impacts?
5. how can we manage this challenge in a strategic way?

Although our approach is aligned with the five yearly planning cycles of our regulators we have also taken a longer 25 year view of climate change impacts as part of our planning for PR09 (see Section 5.1).

We have described our approach to risk both in terms of general business risk but also specific climate change risk. The areas covered included Business Risk Assessment, Asset Operating Risk, Water and Wastewater Risk Framework, Operational Risk Assessment and Flood Risk Planning/Screening/Analysis/Management. The risk to our business associated with climate change is only one of many and must not be considered in isolation. There is a danger that if the focus is solely on climate change then perhaps other nearer term risks could be overlooked.

We are committed to high standards of corporate governance in the management of key risks to the appointed business (for more information see section B1.3 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>). We have explored and provided evidence of how we manage key risks in the context of our business as a whole. In this section these issues are discussed under the following heading:

- investment Planning and the Development of our Business Plan for PR09;
- developing Water and Wastewater Risk Frameworks;
- bottom Up Operational Risk Assessment;
- our Risk Management Procedures;
- major projects;
- cost Benefit Analysis Overview;
- climate Change Impacts and Flooding;
- framework to Assess the Risk of Flooding at Critical Assets;
- climate Change Impacts on Water Resources;
- changes in Rainfall Intensity and Impacts on the Sewerage Network;
- headroom Analysis – Accommodating Climate Change;
- security and emergency risk management;
- the Wider Context - Developing our PR09 Business Plan; and
- working in Partnership to Understand Climate Change



Understanding and responding to climate change impacts and risk is embedded in our overall approach to managing business risk. We have produced a case study on adapting to climate change for UKCIP/DEFRA (see http://www.ukcip.org.uk/images/stories/Business/BCS_ThamesWater.pdf).



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6. Summary of Risks which Affect Functions, Missions, Aims and Objectives

In this section we describe the strategic risks from climate change facing Thames Water using a likelihood/consequence matrix which also, where possible, includes thresholds. We also identify short and long term impacts of climate change and sign post how these have been factored into our overall adaptation response. The likelihood and consequences are quantified as far as possible. Also in this section we identify our priority climate-related risks and the reasons for which they have been prioritised together with the estimated level of impact to business, likelihood and timescales. Where applicable we have identified opportunities which have been identified as a consequence of responding to climate change impacts.

6.1. Climate Change Risks to Thames Water

In our 25 year forward look Strategic Direction Statement, *Taking Care of Water*, published in December 2007, we identified the potential climate change impacts on our business and the actions that we believe we need to take to ensure that we mitigate and adapt effectively and responsibly. The business plan we submitted to Ofwat as part of the PR09 process directly built on the findings of *Taking Care of Water*. Three areas of focus identified through this process were water resource planning (to protect the security of future water supplies such as rivers and groundwater), sewerage network design and asset flood resilience.

As part of the production of our response to the Adaptation Reporting Power we have used a revised semi-quantitative risk assessment framework incorporating expert judgement to review our analysis of climate change risks to our business (see case study '*Expert Judgement Semi-Quantitative Risk Assessment*' on [page 139](#)). This iterative risk assessment was led by our Climate Change Strategy Manager and our Risk and Value Manager. The semi-quantitative risk assessments identified 7 risk areas to the business as a consequence of climate change:

- water treatment;
- flood resilience of water assets;
- water resource;
- water supply network;
- wastewater treatment;
- flood resilience of wastewater assets;
- wastewater network including sewer flooding; and
- sludge management and disposal

6.1.1. Quantifying risk

To assess the risk to the business associated with climate change Thames Water developed a semi-quantitative risk assessment which uses expert judgement. This is a continually evolving and developing methodology that reflects improvements in knowledge, understanding and the degree of adaptive resilience of the businesses assets and processes. For more detail see the '*Expert Judgement Semi-Quantitative Risk Assessment*' case study on [page 139](#).

The original assessment was based on our 2004 assessment of business impacts of climate change. This was based on expert judgement but challenged and validated internally (through workshops) and externally by industry experts, regulators, academics and other stakeholders. Learning from this assessment was directly fed into the development of the WaterUK planning tool to support a common approach to assessing adaptation risks related to asset management planning by Montgomery Watson Haza (<http://www.water.org.uk/home/policy/publications/archive/industry-guidance/asset-management-planning>). The framework was used to validate and support the approach adopted by Thames Water for PR09.

Using this risk assessment framework together with expert judgement we have been able to numerically assess and score level of consequence and level of likelihood to determine level of risk where:

Level of consequence (i.e. what effect the impact would have) was scored as:

- Low = 1 - Short-term impacts that can be managed through contingency planning
- Medium = 2 - Impacts that cannot be managed simply through contingency planning
- High = 3 - Significant failure

Level of likelihood (i.e. is adaptation going to be required) is characterised by:

- Low = 1 - Not likely
- Medium = 2 - Likely
- High = 3 - Very likely

Using a Red, Amber and Green scale it was possible after the aggregation of the scores for Level of consequence x Level of likelihood, to quantify risk where:

- a. Red = Score between 9 and 6
- b. Amber = Score between 5 and 3
- c. Green = Score between 2 and 1

6.1.2. Risk overview

The three prioritised areas of focus identified in *Taking Care of Water* were: water resource planning (to protect the security of future water supplies such as rivers and groundwater), sewerage design and flood resilience. This risk assessment, undertaken as part of the preparation of this report, reinforced the original assessment used in the preparation of our PR09 business plan and validates the actions being taken between now and 2015 (see Table 4 and the '*Expert Judgement Semi-Quantitative Risk Assessment*' case study on [page 139](#)).

Business Area Assessed	Number of risks if no adaptation action taken			Potential of residual risk in an unconstrained adaptation world		
	Red	Amber	Green	Red	Amber	Green
Water Resources	19	12	3	0	24	10
Water Treatment	7	11	3	0	8	13
Water Networks	9	9	1	0	15	14
Wastewater Treatment	14	17	8	0	17	22
Wastewater Networks	14	10	6	0	10	20
Sludge	5	7	2	0	4	10
Totals	68	65	23	0	78	78

Table 4: High Level Overview of Semi-quantitative Risk Assessment

6.1.3. Residual Risk

In an unconstrained world (i.e. no financial, political or regulatory constraints) it would be possible to positively manage climate change impacts in a way that would reduce these impacts and therefore reduce risk. The scoring methodology for this assessment is explained in the '*Expert Judgement Semi-Quantitative Risk Assessment*' case study on [page 139](#).

Based on what we know today about the issues highlighted, our analysis suggests that in an unconstrained adaptation world then it is potentially possible to manage all the high level red risks (68) down to Green or at Amber. Not all risks are equal in terms of size and criticality of impact and this will allow the business further opportunities to manage the residual risk of climate change. Similarly the confidence in individual assessments is variable and we will seek to improve this where possible going forward.

As previously stated in Section 5.2, it must be remembered that the risk to our business associated with climate change is only one of many and must not be considered in isolation. Therefore to avoid the danger of focusing solely on climate change and perhaps other nearer term risks being overlooked we have incorporated climate change assessments into our long-term business planning processes.

6.1.4. Threats and Opportunities

Our analysis so far has established that climate change is predominantly a risk for our business (as described in Section 5 and Table 4) with very few opportunities being identified. The main opportunities that we have identified are around carbon mitigation e.g. renewable energy generation and adaptation as a consequence of potentially more raw water being available for collection during the winter period and greater dilution capacity in the river during the winter period to dilute treated effluent.

However, how we respond to the risks we have to manage does provide opportunities to take stock and to do things differently. For example in Section 5.11 where we describe an interim approach to responding to the climate change impact on sewer network.

Because the changes in climate may have a very significant impact on wastewater networks, it is likely that our main long term focus for adapting to climate change will be to limit surface flows to our network where possible and to install controls to maximise the attenuation of flows in our system. We identified that simply delivering “more of the same” i.e. building greater capacity into pipes and tanks would be neither sustainable nor feasible and that we need to develop new options that we can deliver from AMP6 onwards. We also identified that the supporting data on climate change was contradictory. We therefore decided to deploy continuous monitoring equipment at critical points in the network to enable us to better understand flow trend changes and move towards active network management over the next 10 years. We consider that this is a pragmatic approach for taking climate change into account for wastewater assets which will allow us to deploy the most appropriate and sustainable solutions in the future.

6.1.5. Summary assessment of current and future risks due to climate change

Table 5 in this section pulls together and summarises information from across this report on the risks, impacts and responses by the business to climate change under the following headings:



- business function;
- climate variable;
- primary impact of climate variable;
- threshold(s) above which this will affect the organisation;
- likelihood of threshold(s) being exceeded in the future and confidence in the assessment;
- potential impacts on organisation and stakeholders;
- proposed action to mitigate impact; and
- timescale over which risks are expected to materialise and action is planned

The data encapsulates our understanding of how climate change will impact on our business on the treatment and distribution of water and wastewater services, flood resilience and sludge management. It also outlines when we expect changes to impact, some indicative thresholds and the actions we are already delivering or planning to deliver to manage the impacts. We have already started the delivery of adaptive responses in the areas of water resources, water distribution networks and flood resilience.

During our assessment of UKCP09 we have identified that thresholds in changing climate in isolation are not that useful for planning. It is more useful for businesses to understand how sensitive its activities and supporting systems (natural and business) are to climate change impacts. With this information businesses will be able to develop decision making threshold points where they can begin the implementation of adaptation responses once these points are reached. We believe that this is a key learning point for other organisations.

Business function	Climate variable	Primary impact of climate variable	Threshold(s) above which this will affect the organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Water Treatment	Higher temperatures, poorer quality raw waters	Water quality deterioration, reduced effectiveness of treatment and disinfection processes. Increased rate of equipment degradation. Health and Safety issues.	Temperature thresholds are not fully understood. Water quality issues are not solely dependent on climate change.	Low in the next 20 years but increasing. Confidence in assessment is good.	More energy intensive water treatment required. Issues with effectiveness and longevity of disinfection processes. In supply water quality deterioration. Equipment and asset outages. Reduced security of supply.	Undertaking research to better understand sensitivities and thresholds and investigate potential adaptation options. Monitor performance of assets.	Medium to Longer-term. Research underway to better understand the implications and possible responses.
Flood resilience – water assets	More intense rainfall events, increased volumes of surface and flood water. More frequent riverine flooding.	Flooding and loss of asset functionality.	Have assessed all operational sites against a 1 in 100 year event + 20%.	High likelihood with a good confidence of impact if no adaptation action taken	If no action taken - could be loss of assets for extended periods, water quality issues, loss of supply to customer, health and safety, and political, reputational and compliance issues	Increase in physical flood protection. Reconfiguration of supply network to handle outages. Raising equipment above potential flood levels. Seal assets.	Impacts will be incremental over time but variable from this point forward. Planning and implementation of solutions has already started.

Business function	Climate variable	Primary impact of climate variable	Threshold(s) above which this will affect the organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Water Resources	Drought & reduced rainfall.	Changes to water availability, recharge and quality. Reduced flow in river during the summer with consequent reduction in resource availability. Increased evapo-transpiration and demand by environment reducing water availability. Accelerated rate of degradation of infrastructure.	Historically uncertainty around climate change has been accommodated using a headroom approach rather than thresholds. We also monitor our status against thresholds included in our Drought Plan.	Almost certain. Confidence is high based on UKCIP02 and UKCP09 – assumes these projections are realistic based on emission forecasts used.	More frequent supply restriction such as non-essential use and hosepipe bans. Potential impact on business and domestic customers. Political, reputational and compliance issue.	New resources, innovation, water efficiency. Currently undertaking assessment of impacts with UKCP09. We are undertaking research to better understand sensitivities and thresholds and investigate potential adaptation options. Develop new water resources and seek to reduce demand. Statutory requirement to consider climate change in plans.	We already accommodate climate change impacts in water resource planning. Incremental but variable from this point forward. Planning and implementation of solutions has already started.

Business function	Climate variable	Primary impact of climate variable	Threshold(s) above which this will affect the organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Water supply network	Wetting/drying of soil replacing freezing/thawing	Increased leakage and bursts due to soils movement. Loss of pumping stations due to flooding. Accelerated rate of degradation of infrastructure.	Gradual change from freezing/thawing to wetting/drying. Gradual shift anticipated not a step change.	Very likely with moderate confidence. Difficult to separate out the different causes but impact is the same.	Increased supply outages. Interrupted supply to customers. Potential for contamination of supply. Political, reputational and compliance issue.	Network replacement i.e. via the Victorian Mains Replacement scheme which replaced 1300Km 2005-10. Predictive failure modelling prioritisation of pipe replacement. Monitoring of asset performance.	Gradual shift anticipated not a step change. We have already started the replacement of cast iron Victorian mains with plastic pipes (1300 Km in AMP4) this will improve resilience to wetting/drying cycles.

Business function	Climate variable	Primary impact of climate variable	Threshold(s) above which this will affect the organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Wastewater treatment	More intense storms, higher temperatures and changes in river flows	Changes in strength and volumes of sewage flows arriving at treatment works. Impact on process efficiency. Greater treatment required as a consequence of reduced dilution capacity in rivers. Increased sewage septicity. Accelerated rate of degradation of infrastructure. Sea level/storm surge impacts for some London works.	Temperature thresholds are not fully understood. Water quality issues are not solely dependent on climate change.	Low in the next 20 years but increasing. Confidence in assessment is good.	Loss of asset/service. Tighter discharge consents requiring more energy intensive treatment solutions. Political, reputational and compliance issue.	Better modelling & understanding of impacts of climate change on flows to be treated. Undertaking research to better understand sensitivities and thresholds and investigate potential adaptation options. Monitor performance of assets. Separate surface water flows from foul network e.g. SuDS for new developments	Medium to Longer-term. Research underway to better understand the implications and possible responses.

Business function	Climate variable	Primary impact of climate variable	Threshold(s) above which this will affect the organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Flood resilience - Wastewater	More intense rainfall events, increased volumes of surface and flood water. More frequent riverine flooding.	Flooding and loss of asset functionality	Have assessed all operational sites against a 1 in 100 year event + 20%.	High likelihood with a good confidence of impact if no adaptation action taken.	If no action taken there could be loss of assets for extended periods, water quality issues, loss of supply to customer, health and safety, and political, reputational and compliance issues.	Increase in physical flood resilience. Protect where appropriate. Raising equipment above potential flood levels. Seal assets.	Impacts will be incremental over time but variable from this point forward. Planning and implementation of solutions has already started.
Wastewater network including sewer flooding	More intense storms. More frequent high intensity rainfall events. Wetting/drying of soil due to changes in temperature and precipitation.	Surcharging due to more intense storms leading to Sewer flooding. Wetting/drying leading to subsidence. More frequent flooding of pumping station etc	We already have surcharging issue and know where the hot spots are. Climate change is likely to increase the number of hot spots and frequency of incidents	Already a problem.	Sewer flooding and damage to customer properties. Political, reputational and compliance issues.	Improving catchment models during AMP5 and applying UKCP09 projections. Will target high risk areas first, new approaches, SuDS, catchment management in conjunction with conventional solutions.	From now on. Assessments taking place during AMP5 (see Section 6.14).

Business function	Climate variable	Primary impact of climate variable	Threshold(s) above which this will affect the organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Sludge management and disposal	Wetter winters and access to land. Drier summers.	Access to land may be restricted during wetter winters. Changes in agricultural practices. Changes to contaminants in sludge.	Water quality issues are not solely dependent on climate change.	Low in the next 20 years but increasing. Moderate confidence in assessment.	Inability to beneficially dispose of treated biosolids. Potential for stockpiling issues around leachate and odour. Political, reputational and compliance issues.	Better understand sensitivities and thresholds. Investigate potential adaptation options. Monitor performance of activity impacts.	Medium to Longer-term.

Table 5: Summary assessment of current and future risks due to climate change

6.1.6. Desegregation of risk by location

It is not always possible to disaggregate risk down to location. For example Drought invariably impacts on the whole of the business area. However, for flood issues it is possible to be spatially specific and we have disaggregated our analysis and planning prioritisation down to individual sites and assets (see Section 5.10).

6.1.7. Indicative Costs

In our final Business Plan submission to Ofwat in 2009 the following costs (circa £300 million) were included as climate change related-activity between 2010 and 2015 but this was not necessarily funded. There will always be uncertainty about the size, rate of change and timing of climate change impacts. Because of this uncertainty there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. There are concerns about the timeliness of response (too early) or degree of response (too much) and wasted adaptation investment, which in a regulated industry will ultimately impact on customer bills. However, this must be balanced with the need to encourage and ensure adaptation responses are in place in time.

Activity	Adaptation Response	Indicative Cost (£m)
Flooding Resilience	Protection of 11 Water Treatment Works and six pumping stations to a 1:100+20% return period flood (see Section B6.2 of our Final Business Plan).	17.0
	Protection of our highest risks at 10 major and 3 minor Sewage Treatment works and 37 pumping stations protecting sewerage services to approximately 4.9m PE (see Section B6.3 of our Final Business Plan).	20.0
	Provision of flood compensation for Hampton Water Treatment Works (as per PPS 25 requirements) ³ .	20.0

³ Costs not included in Final Business Plan see Section 9.2 Barriers to Adaptation.

Activity	Adaptation Response	Indicative Cost (£m)
Water Resources	Victorian Mains Replacement (400km) and 125,000 Selective Meters ⁴ .	230.0
Sewer Flooding	Deployment of continuous monitoring equipment at critical points in the network to enable us to better understand flow trend changes and move towards active network management over the next 10 years.	9

Table 6: Indicative Costs of Adaptation

We discuss some of the tensions between costing adaptive solutions and securing funding for implementation in Section 9.

6.2. Section Summary

The three prioritised areas of focus identified in *Taking Care of Water* were: water resource planning (to protect the security of future water supplies such as rivers and groundwater), sewerage design and flood resilience. This risk assessment, undertaken as part of the preparation of this report, reinforced the original assessment used in the preparation of our PR09 business plan and validates the actions being taken between now and 2015 (see Table 4).

In an unconstrained world (i.e. no financial, political or regulatory constraints) it would be possible to positively manage climate change impacts in a way that would reduce these impacts and therefore reduce risk.

The risk to our business associated with climate change is only one of many and must not be considered in isolation. Therefore to avoid the danger of focusing solely on climate change and perhaps other nearer term risks being overlooked we have incorporated climate change assessments into our long-term business planning processes. The main opportunities that we have identified are around carbon mitigation e.g. renewable energy generation and adaptation as a consequence of potentially more raw water being available for collection during the winter period and greater dilution capacity in the river during the winter period to dilute treated effluent. However, how we respond to the risks we have to manage does provide opportunities to take stock and do things differently. For example in Section 5.12 where we describe an interim approach to responding to the climate change impact on the sewer network.

⁴ Not funded in PR09 Final Determination.



During our assessment of UKCP09 we have identified that thresholds in changing climate are not that useful for planning. It is essential for businesses to understand how sensitive its activities and supporting systems (natural and business) are to climate change. With this information businesses will be able to develop decision making threshold points where they can begin the implementation of adaptation responses. We believe that this is a key learning point for other organisations.

In our final Business Plan submission to Ofwat in 2009 costs for flooding, water resources and sewerage networks were included (but not necessarily funded) for climate change-related adaptation activity between 2010 and 2015. Indicative costs included in our Final PR09 Business Plan were just under £300 million.

7. Actions Proposed to Address Risks

In this section we describe actions proposed to address risks, that we expect to deliver before 2015. We also describe how our adaptation plans are linked to our wider sustainability objectives and the benefits we expect the measures to bring to the business.

We have already identified in Section 6 our key climate change risks and the timescales over which the impacts will occur and that we need to respond by, together with some indicative costs. Our longer term adaptation plans are described in Section 11 and our Strategic Direction Statement.

7.1. *Adapting to climate change*

Some effects of climate change are unavoidable due to historic greenhouse gas emissions. Expected changes in the frequency and intensity of droughts and other extreme weather conditions will be felt across our business. We will also face indirect impacts, such as increased demand for water. We need to adapt to these changing pressures and keep up to date with the latest thinking on climate change.

Looking forward we have started the process of delivering adaptation solutions in our five-year plan that we will deliver between 2010 and 2015 as part of our AMP5 Capital Programme. This is a defined programme which is monitored by the Executive Management Team on a monthly basis with primary responsibility for delivery sitting with our Asset Management Director.

We have identified that we need to protect our major sites from flooding and in response we intend to improve flood resilience at fifteen water and two wastewater assets by 2015. In addition we also raised the design standard for sewerage installations that will be delivered over the next five years which will help improve the capacity of sewers to cope with heavier storms. We have also begun working with Ofwat, the Environment Agency, UKCIP and key academics to establish how best to apply the UKCP09 projections to water resource planning (see Section 11.3). Our specific actions are covered in more detail below.



7.1.1. Sustainability

In our final Business Plan we explained the importance of sustainability for our business and identified a number of new challenges that will have sustainability implications for our business for the period from 2010-15 and beyond. These issues included:

- Adapting to the inevitable impacts of climate change, and mitigating our avoidable contributions to climate change
- Responding to tighter legislation across a broad range of environmental issues
- Challenging the way we operate in order to respond to social and demographic change (such as population growth and changes in household occupancy) and evolving customer expectations.

Sustainability will guide our long-term strategy and business planning into the future. It is fundamental to the way we run our business and our approach for AMP5. Our desire to be a leading and responsible business means a strategic approach to sustainability is required for the future. This is reflected in our Strategic Direction Statement ('Taking care of water'), Business Plan, Sustainability Assessment Framework and broader business activity.

Our approach to sustainability provides a high-level overview of the importance of sustainability to our business and a framework for recognising and addressing sustainability risks and opportunities including climate change. It set out a number of immediate actions for our business and a target-driven route for performance improvement and potential leadership on sustainability (for further details of the framework please refer to the final Business Plan Appendix B1 (a) and case study '*Climate Change Adaptation and Sustainability*' on [page 145](#)).

With input from Forum for the Future (the sustainable development charity), we had developed an assessment framework that enabled us to assess our sustainability performance at both a strategic (programme) and a project level (see Section B1.1.4 of our final Business Plan). We assessed our final Business Plan against the strategic framework. The results show improvements across a range of programmes between our draft and final Business Plan submissions to Ofwat, and clearly establish a baseline against which we can identify and tackle sustainability issues, now and into the future. Application of the framework identified that notable improvements were made across climate change, investment, governance and asset management between draft and final submission.



Through our project-level sustainability checklist and assessment procedure, we will embed more detailed sustainability consideration (including climate change) into project-level planning, design and implementation. This is being integrated into capital delivery procedures and performance management of AMP5 projects.

7.2. Climate Change Adaptation Responses included in PR09

The development of our Business Plan for PR09 has taken into account the proposals in the Climate Change Act 2008 on how public bodies and statutory undertakers need to carry out their own risk assessment and make plans to address the risks associated with climate change. There are three main strands to our adaptation response to climate change: Water Resources, Flood Resilience and Sewerage Networks, which we included in our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

7.2.1. Water Resources

One of the most significant drivers for investment in our revised Business Plan is the forecast impact of climate change on both water available for use and the demand for water (see Section B5.1 of our Final Business Plan for full details <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

Our adaptive response to the effects of climate change on water resources has two elements to it:

- 1) To reduce the future demand for water through reducing water losses from its water distribution network and encouraging customers to reduce their demand for water and;
- 2) Increasing the availability of raw water supply during hot, dry periods through the provision of additional water storage which captures excess winter river flows.

Looking forward our high-level plans to deliver water resources supply/demand solutions (subject to approval and appropriate funding) in the context of climate change are described below:

- Leakage control measures include a forecast 3000 km distribution mains rehabilitation programme in London over the next 10 years to reduce losses from the old cast iron Victorian water mains in the capital, supported with additional trunk main repairs, pressure management and zonal reconfiguration schemes to reduce the rate of leakage from other parts of the network. This is forecast to reduce leakage in the region of 75 Ml/d;



- Demand reduction measures are expected to include the roll out of household meter installation on all connected properties throughout the company's supply area in the period to 2025 which will result in approximately 80% of individual household properties paying for their water usage on a measured volumetric tariff, and the remaining common supply households paying on an assessed measured tariff. It is anticipated that these measures in total will reduce forecast household consumption from approximately 160 l/h/d to 135 l/h/d by 2035; and
- Additional raw water supplies could be facilitated through the construction of a new surface water reservoir to capture excess winter high flows so that this water can subsequently be released back into the River Thames during summer low flow periods to support existing surface water abstractions downstream in London. Not only would the reservoir provide additional water to meet customer's demands, it would also support the ecology and navigation in the River Thames which would otherwise be impacted during prolonged periods of hot, dry weather. The construction of such a reservoir is currently forecast to be required during the 2020s although no decision has yet been made

Even for the early stages of the 25-year Water Resource Management Plan during AMP5 the impacts of climate change are highly significant. For our draft Business Plan we based our assessment of climate change-driven investment on the UKCIP02 climate change scenarios for the full five years of AMP5. However in response to Ofwat's guidance on climate change, set out in PR09/20, we removed a significant proportion of climate change driven investment from our final Plan. In the Final Determination Ofwat determined not to include the remaining water resources investment with a climate change driver. We discuss this further in Section 9 Barriers to Adaptation.

We are now developing our assessment of the impacts of climate change on water resources using the UKCP09 projections with Ofwat, Environment Agency and UKCIP (see also Section 11.6 and the '*Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand)*' case study for more information on [page 153](#)). This work will inform our decision on whether to submit a proposal to Ofwat for an Interim Determination of K as a Notified Item.

In addition, because water resource management is integrally linked with drought management planning we need to ensure that we plan appropriately for the possibility of our region experiencing drought conditions. We describe our Drought Planning approach in Section 10.8.

7.2.2. Flood resilience

Our work for the final Business Plan is based on best practice modelling of the flood extent and depth at 3842 of our operational sites. This has incorporated both fluvial and pluvial flooding. We have taken a pragmatic view of adopting flood resilience rather than flood resistance, and only sought to protect sites when there are clear operational reasons for doing so. We have assumed that other flood resistance measures currently maintained by others, including the Thames Barrier, will continue to protect our works. We have reviewed our plans with the EA who have accepted our approach in principle.

Our flooding resilience programme (as describe above in Section 5) is based on Ofwat's 3-staged approach for flood hazards assessment or Service Risk Framework (SRF), planning methodology, best value solution and cost benefit analysis, and hence our AMP5 investment focuses on our most critical assets. Where the term resilience is used it refers to the enabling the site to continue to function, whilst flooded, or minimising the impact of the flood. Full details of our flooding resilience programmes for water and wastewater are given in Section B6 of our final Business Plan

(<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

7.2.3. Wastewater Assets - Flood Resilience

Our draft Business Plan included a programme of investment to protect our wastewater facilities at highest risk of flooding. Ofwat commented on our draft Plan, and removed this element of investment out of the draft baseline because the plans were not sufficiently developed at the time. To address this comment we carried out significant work between the Draft Business Plan and Final Business Plan to address these questions that were raised. In particular we carried out the following activities:

- specifically followed the Ofwat document "Asset Resilience to Flood Hazards: An analytical framework";
- assessed the current level of protection for each site in the plan and defined the new levels of protection;
- visited all the principal locations in our plan and assessed alternatives;
- completed a Cost Benefit Analysis for each location included in our plan; and
- redefined our investment from Base into Enhanced expenditure



For the Final Business Plan we reduced its scope and associated costs by removing all non-cost beneficial schemes - and only sought to deliver solutions to the most critical locations. We also identified that expenditure in future AMP periods was expected.

Our final business Plan programme consisted of 50 wastewater sites, which are all cost beneficial. The investment covers the more critical sites and does not include any costs for flood compensation. Although the proposed investment during this period would not cover all sites we prioritised actions based on the assessment described in Section 5.2.7. However, funding was only allowed for two of these sites in Ofwat's Final Determination, the reason for this is discussed in Section 9 - Barriers to Adaptation and Interdependencies. Those operational sites which receive flood protection will be protected to a level of a 1 in 100 year +20% return period event. For those sites which were not allocated funding in the Final Determination flood resilience activity has been deferred until AMP6 together with the associated risk.

In line with prioritised and proportionate climate change adaptation responses we anticipate the need for further investment in future AMP periods will be required to manage further flooding risks at less critical sites.

7.2.4. Water Supply Assets – Flood Resilience

The approach adopted for water supply sites was the same as for wastewater sites and followed the Ofwat document "Asset Resilience to Flood Hazards: An analytical framework". Our final Business Plan programme consisted of 17 water sites in London and the Thames Valley, emergency water supplies and works to reinforce dam and reservoir safety at seven reservoirs. The water programme is cost beneficial. The investment covers the more critical sites and includes costs for flood compensation except for Hampton Water Treatment Works. Those operational sites which receive flood protection will be protected to a level of a 1 in 100 year +20% return period event.

We have reviewed our plans with the EA who have accepted our approach in principle. They have confirmed the need for flood compensation and have assessed a number of our sites in detail, including Hampton Water Treatment Works (WTW). At Hampton WTW we found the costs associated with flood compensation storage is excessive (circa £20 million) in relation to the cost of construction. We therefore did not include the cost of our flooding compensation storage at this site, as we consider it is an inappropriate response to the need and not cost beneficial. Without flood compensation we may not be able to deliver the required flood resistance solution but are exploring the potential for other mechanisms for compensation

delivery other than direct provision of like for like storage. We will discuss this issue further in Barriers to Adaptation and Interdependencies.

7.2.5. Sewerage design standards

In AMP5 we will continue to develop our sewerage network schemes designed to the uplifted standard to provide alleviation up to a 1 in 30 year storm event which is the current defacto industry standard level of protection⁵. In addition we intend to review the need for additional uplift over and above this using UKCP09 data (see Section C6 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm> and 'Adapting Sewerage Networks to Climate Change' case study on [page 157](#)). Throughout AMP5, we also intend to improve our understanding of our catchments through our Drainage Area Planning programme detailed in Section B3 of our final Business Plan. Moving forwards 'more of the same' e.g. building greater capacity into pipes and tanks, should not be the only adaptation response to climate change. For AMP6 and beyond other options including sustainable drainage systems (SuDS), storm water charging and redesigning catchments and buildings may become viable sustainable options to alleviate the risk of sewerage networks.

7.3. Major Capital Projects and climate change

We may be required to deliver some large single engineering projects in the coming decade definitely including the Tideway project (comprising the Lee Tunnel & Beckton Sewage Treatment Works Extensions) and possibly the Thames Tunnel and the Upper Thames Reservoir in the 2020s.

7.3.1. The Tideway Project

Although this project is not driven by climate change it has nonetheless been screened for the proposed solution's sensitivity to the impacts of climate change (see case study on 'The Thames Tunnel and Climate Change' on [page 167](#)) and further sensitivity analysis is planned. By nature, the assessment of climate change includes inherent uncertainties, and the objective is to ensure that the final scheme is adaptable in light of this uncertainty. The evidence gathered and analysed indicates that the Thames Tunnel offers significantly more flexibility in an uncertain environment, compared to the baseline conditions until the 2080s.

⁵ There is currently no specified industry design standard only a common level used by the majority of the sector.

This is a high profile project which is supported at Ministerial level and by the Mayor of London which received extensive scrutiny from the Environment Agency, Defra and Ofwat. More information on the proposed project and climate change can be found at <http://consense.opendebate.co.uk/files/thamestunnel/1-100-RG-PNC-00000-900007%20Needs%20Report.pdf>. It should be noted that although Thames Water are leading on this project it is currently undecided who will be responsible for the delivery of the project.

7.3.2. The Proposed Upper Thames Reservoir

Climate change has explicitly been included in the development of the needs case of this project (see Section B5 Managing the Supply/Demand Balance of our final Business Plan <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>). We are awaiting a decision from the Secretary of State about the acceptability of our Water Resources Management Plan following a Public Inquiry held during the summer of 2010. As a consequence at this time it is unclear whether we will be able to deliver this project and the associated climate change adaptation benefits (see also Section 9 Barrier to Adaptation and Interdependencies).

7.4. *Working with others*

Climate change remains a key challenge for society, and we intend to continue to work, share information/learning and funding with a wide range of organisations:

- DEFRA
- Environment Agency
- Ofwat
- The Greater London Authority
- The Tyndall Centre for Climate Change Research
- Research Councils
- London Climate Change Partnership
- Climate Southeast
- The cross regional Three Regions Climate Change Partnership

As a member of the Prince of Wales's Corporate Leaders' Group on Climate Change, we are working at the highest levels within business and government to help develop new, longer-term policies to tackle climate change. As part of this group we have been proactive in ensuring that the need for adaptation is highlighted, understood and promoted.

At the industry level we are an active member of the WaterUK Climate Change Forum, which is working to ensure that adaptation and mitigation work across the water industry are appropriate, sustainable and equitable.

We believe that it is important for individual organisations and sectors to share learning and understanding wherever possible or practical. This is why we are actively engaged with the organisations identified above. For more information see the following case studies; *'Adaptation through Managing Water Demand'* on [page 161](#), *'Climate Change Research 1997 to 2010'* on [page 131](#) and *'Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand)'* on [page 153](#).

Our approach to collaborative research has enabled us to develop our understanding of the implications of climate change and also our contribution to it. This has informed our adaptation prioritisation and the development of adaptation responses.

The outputs from the research have increased our knowledge of climate change, helped establish quantitative impacts, identify areas where there is uncertainty and enable us to contribute and participate in the wider climate change debate. As importantly it has also allowed us to develop common and consistent understanding of the issues we face across the sector. It has also allowed us to highlight to a wide variety of stakeholders the potential impact of climate change on the water sector.

7.5. Benefits Delivery

The adaptation benefits from schemes delivered as part of the AMP5 programme will be in place by 2015. Delivery of adaptation projects beyond 2015 have yet to be developed, costed, funded or confirmed.

It should be highlighted that some unrelated projects outputs will also deliver serendipitous climate change adaptation benefits in addition to their main drivers. For example, our Victorian Mains Replacement programme to replace failing Victorian cast iron pipes with new plastic pipes. This programme is primarily intended to reduce leakage of potable water from the supply network. However, it delivers additional benefit to the business and our customers as reduced leakage avoids unnecessary treatment and pumping costs and thereby saves energy and so has a positive carbon mitigation and cost benefit. It also reduces wastage of water and thereby conserves water supplies, a positive climate change adaptation response. In addition, the supply network also becomes more resilient to ground movement expected to increase as a consequence of the wetting and drying of the soil associated with



climate change. This is because plastic pipes are more flexible than the existing brittle cast iron pipes.

We also expect to see similar serendipitous climate change benefits for water supply associated with our Network Improvement Programme (a reduction of the pressure within distribution pipes and associated reduction in leakage), Thames Gateway Water Treatment Plant (the desalination plant which allows previously unavailable and treatable brackish water to be treated and put into the general water supply without impacting on existing water resources) and water efficiency (which reduces demand thereby conserves water supplies).

7.6. Section Summary

In this section we describe actions proposed to address risks that we expect to deliver before 2015. We also describe how our adaptation plans are linked to our wider sustainability objectives and the benefits we expect the measures to bring to the business.

We have already identified in Section 6 our key climate change risks and the timescales over which the impacts will occur and that we need to respond together with some indicative costs. Our longer term adaptation plans are described in Section 11 and our Strategic Direction Statement '*Taking Care of Water*'.

Looking forward we have started the process of delivering adaptation solutions in our five-year plan that we will deliver between 2010 and 2015 as part of our AMP5 Capital Programme. This is a defined programme which is monitored by the Executive Management Team on a monthly basis with primary responsibility for delivery sitting with our Asset Management Director.

In our final Business Plan we explained the importance of sustainability for our business and identified a number of new challenges that will have sustainability implications for our business for the period from 2010-15 and beyond. These issues included:

- adapting to the inevitable impacts of climate change, and mitigating our avoidable contributions to climate change;
- responding to tighter legislation across a broad range of environmental issues; and
- challenging the way we operate in order to respond to social and demographic change (such as population growth and changes in household occupancy) and evolving customer expectations.



Sustainability will guide our long-term strategy and business planning into the future. It is fundamental to the way we run our business and our approach for AMP5. Our desire to be a leading and responsible business means a strategic approach to sustainability is required for the future. This is reflected in our Strategic Direction Statement ('Taking care of water'), Business Plan, Sustainability Assessment Framework and broader business activity.

The development of our Business Plan for PR09 has taken into account the proposals in the Climate Change Act 2008 on how public bodies and statutory undertakers need to carry out their own risk assessment and make plans to address the risks associated with climate change. There are three main strands to our adaptation response to climate change, Water Resources, Flood Resilience and Sewerage Networks, which we included in our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

One of the most significant drivers for investment in our revised Business Plan is the forecast impact of climate change on both water available for use and the demand for water (see Section B5.1 for full details <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>). In the Final Determination Ofwat disallowed water resources investment with a climate change driver. We discuss this further in Section 9 Barriers to Adaptation. There therefore remains uncertainty about what water resource adaptation will be delivered before 2015.

However, we are now developing our assessment of the impacts of climate change on water resources using the UKCP09 projections with Ofwat, Environment Agency and UKCIP (see also Section 11.6 and the '*Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand)*' case study for more information on [page 153](#)). This work will inform our decision whether to submit a proposal to Ofwat for an Interim Determination of K as a Notified Item.

Our flood resilience work used to inform our final Business Plan was based on best practice modelling of the flood extent and depth at 3842 of our operational sites. This has incorporated both fluvial and pluvial flooding. We have taken a pragmatic view of adopting flood resilience rather than flood resistance, and only sought to protect sites when there are clear operational reasons for doing so. We have assumed that other flood resistance measures currently maintained by others, including the Thames Barrier, will continue to protect our works. We have reviewed our plans with the EA who have accepted our approach in principle.



Our flooding resilience programme (as describe above in Sections 5.9 and 5.10) is based on Ofwat's 3-staged approach for flood hazards assessment or Service Risk Framework (SRF), planning methodology, best value solution and cost benefit analysis, and hence our AMP5 investment focuses on our most critical assets. Where the term resilience is used it refers to enabling the site to continue to function, whilst flooded, or minimising the impact of the flood. Full details of our flooding resilience programmes for water and waste are given in Section B6 of the final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

In AMP5 we plan to uplift our design standard for sewerage networks schemes to provide alleviation up to a 1 in 30 year storm event. In addition we intend to review the need for additional uplift over and above this as soon as the UKCP09 data becomes available (see Section C6.3.7 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>)). Throughout AMP5, we also intend to improve our understanding of our catchments through our Drainage Area Planning programme detailed in Section B3 of our final Business Plan. Moving forwards 'more of the same' e.g. building greater capacity into pipes and tanks, should not be the only adaptation response to climate change. For AMP6 and beyond other options including sustainable drainage systems (SuDS), storm water charging and redesigning catchments and buildings may become viable sustainable options to alleviate the risk of sewerage networks.

We may be required to deliver some large single engineering projects in the coming decade definitely including the Tideway project (comprising the Lee Tunnel & Beckton Sewage Treatment Works Extensions) and possibly the Thames Tunnel and the Upper Thames Reservoir in the 2020s.

Climate change remains a key challenge for society, and we intend to continue to work, share information/learning and funding with a wide range of organisations. We believe that it is important for individual organisations and sectors to share learning and understanding wherever possible or practical. This is why we are actively engaged with the organisations identified in Section 7.4.



8. Uncertainties and Assumptions

In this section we describe the main uncertainties in the evidence, approach and method used in the adaptation programme and in the operation of the organisation. We also highlight the assumptions that have been made when devising the programme for adaptation.

8.1. *Business Risk Assessment - Managing Key Risks and Uncertainties*

We are committed to high standards of corporate governance in the management of key risks to the appointed business. For more information see section B1.3 of our final Business Plan and Section 5 of this report.

8.2. *Uncertainties and UKCIP02 Climate Change Scenarios*

Given its potential impacts on our business operations, we have considered the implications of climate change throughout the development of our final Business Plan for PR09. The UKCIP02 climate change scenarios predict that, by the 2050s, summers will become drier (by 20-40%) and winters will become wetter (by 10-20%). For the purposes of our business planning, we assumed that the then unpublished UKCIP climate change projections (UKCP09) and how they will affect our plan would be broadly consistent with UKCIP02 scenarios. We spoke with both the Hadley Centre and UKCIP who broadly supported this assumption.

8.3. *Uncertainties and the new UKCP09 Probabilistic Climate Change Projections*

The UKCP09 projections have not reduced the uncertainty associated with future climate change. The projections have essentially only managed the uncertainty related to the underlying modelling and provided envelopes of probability distributions of future climates. The uncertainty regarding how different the future climate will be still remains. For more information about how we are assessing how to use the outputs from UKCP09 please see case study 'Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand) on [page 153](#)'.

8.4. Assumptions on Regulation

Until the review of Ofwat has been concluded and the reorganisation of the Environment Agency has been completed we have assumed that the regulatory regime will be predominantly similar to that in 2010. We have not assumed any impact as a consequence of the Comprehensive Spending Review as no change in regulatory functions is yet certain. In addition, we have assumed that we need to deliver the same Level of Service to customers and the environment. We will continue to include in the development of future Business Plans prioritised/risk based climate change adaptation responses, however, delivery of such schemes will be dependent on securing funding in future Price Reviews.

8.5. Assumptions and flood resilience planning

Our work for the final Business Plan is based on best practice modelling of the flood extent and depth at 3842 of our operational sites based on a 1 in 100 year event plus 20%. We have assumed that other flood resistance measures currently maintained by others, including the Thames Barrier, will continue to protect our works. We have reviewed our plans with the EA who have accepted our approach in principle. We have not assumed any additional uplift in wastewater network design standards other than that described in Section 7.2.3.

8.6. Water Resources and Climate Change Uncertainty

To calculate the supply-side impacts for our Final Business Plan, the Company adopted the UKWIR06 methodology (which it helped develop through UKWIR) as recommended in the Environment Agency's Water Resources Planning Guideline. Factors from six global climate models have been used to produce rainfall and evaporation data to feed into our Water Resources Management System (WARMS). In addition the impacts of climate change on groundwater sources have been reviewed following the new methodology.

8.6.1. Water Resources Handling Uncertainty – Headroom

Almost all the components of supply and demand together with their associated planning assumptions are subject to uncertainty. Therefore, how uncertainty is allowed for is of fundamental importance in supply demand planning. The approach taken in developing our final Business Plan and Water Resource Management Plan followed the latest water industry methodology, which uses a margin of safety termed 'Target Headroom' (TH) as a buffer between supply and demand. Target Headroom' is added to demand and the need for new additional water management options is triggered when Target Headroom' and demand



exceed supply capability. Target Headroom includes an allowance for climate change. The exception is leakage uncertainty, for which it is beneficial to undertake a separate detailed modelling exercise to calculate risk and to understand how it can be appropriately managed (for details see Section B5 Managing the Supply/Demand Balance of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>)).

There is an industry standard procedure for calculating Target Headroom', which includes the key components of supply and demand (see Section B5 Managing the Supply/Demand Balance of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>)).

8.6.2. Uncertainty in Changes in Rainfall Intensity and impacts on the sewerage network

Climate change is already acknowledged to be affecting weather patterns, and is generally expected to increase storm intensity. Analysis using UKCIP02 climate change scenarios has shown that parts of our region in the west of the Thames Valley may experience increased storm intensity due to climate change whilst London and the east may have less frequent but more intense storms (a range of +45% to -20% from today by 2080) i.e. extremely uncertain.

However until more accurate probabilistic data is available to allow us to model the effect of climate change on our wastewater assets we cannot promote schemes or put a cost on the impact effectively. The primary impact of climate change will be on sewer infrastructure. Therefore we have not included any specific funding under this driver apart from the change in our design standards for flood alleviation to a level of 1 in 30 years⁵. This is discussed in B5.2.4.1 of our final Business Plan (<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>).

8.7. Section Summary

We have considered the implications of climate change throughout the development of our final Business Plan for PR09. The UKCIP02 climate change scenarios predict that, by the 2050s, summers will become drier (by 20-40%) and winters will become wetter (by 10-20%). For the purposes of our PR09 business planning, we assumed that the then unpublished UKCIP climate change projections (UKCP09) and how they will affect our plan would be broadly consistent with UKCIP02 scenarios. We spoke with both the Hadley Centre and UKCIP who broadly supported this assumption.



The UKCP09 projections have not reduced the uncertainty associated with future climate change. The projections have essentially only managed the uncertainty related to the underlying modelling and provided envelopes of probability distribution of future climates. The uncertainty about how different the future climate will be still remains. For more information about how we are assessing how to use the outputs from UKCP09 please see case study Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand) on [page 153](#).

To calculate the water supply-side impacts for our Final Business Plan, the Company adopted the UKWIR06 methodology (which it helped develop through UKWIR) as recommended in the EA's Water Resources Planning Guideline. How uncertainty is allowed for is of fundamental importance in supply demand planning. The approach taken in developing our final Business Plan and Water Resource Management Plan followed the latest water industry methodology, which uses a margin of safety, which includes an allowance for climate change, termed 'Target Headroom' (TH) as a buffer between supply and demand.

Until more accurate data is available to allow us to model the effect of climate change on our wastewater assets we cannot promote schemes or put a cost on the impact effectively. The primary impact of climate change in this area will be on sewer infrastructure. We believe that simply delivering "more of the same" i.e. building greater capacity into pipes and tanks will not be either sustainable or feasible. During AMP5 we will develop better data and explore new solution options that we will incorporate into our AMP6 planning onwards. This will help ensure that we do not maladapt our sewerage network to climate change impacts.

Until the review of Ofwat has been concluded and the reorganisation of the Environment Agency has been completed we have assumed that the regulatory regime will be predominantly similar to that in 2010. We have not assumed any impact as a consequence of the Comprehensive Spending Review as no change in regulatory functions is yet certain. In addition, we have assumed that we need to deliver the same Level of Service to customers and the environment. We will continue to include in the development of future Business Plans prioritised/risk based climate change adaptation responses, however, delivery of such schemes will be dependent on securing funding in future Price Reviews.

9. Barriers to Adaptation and Interdependencies

In this section we describe the barriers we have identified to successfully delivering adaptation responses. Where possible we describe opportunities to overcome these barriers. We also highlight a number of interdependencies that need to be considered including our key stakeholders.

As the Coalition Government has already recognised with energy planning we consider that providing safe clean drinking water and efficient wastewater services is too important to rely on “just in time planning” while seeking an unachievable level of certainty about the future in terms of size and timing of climate change impacts.

9.1. *Best Available Science!*

There will always be uncertainty about the size, rate of change and timing of climate change impacts. Because of this uncertainty there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. There are concerns about the timeliness of response (too early) or degree of response (too much) and wasted adaptation investment, which in a regulated industry will ultimately impact on customer bills. However, this must be balanced with the need to encourage and ensure adaptation responses are in place in time.

In order to avoid significant additional costs associated with delaying plan delivery, in our final Business Plan submission we included some climate change-driven investment costs and outputs for the first two years of the planning period (2010/11 and 2011/12) using the then available best science. We proposed then to submit an update of our Business Plan, based on UKCP09 climate change projections, within the AMP5 period, to justify the investment required for the last three years of the five-year period. We believed this was a sensible, measured and prudent approach which we discussed with Ofwat ahead of submitting our final Business Plan.

In the development of our final Business Plan for PR09 we stated that we believed that the revised UKCP09 projections when published would support the requirement for investment in water resources driven by climate change. The work we have undertaken on trying to understand and apply UKCP09 to business planning, although not yet completed, is supportive of this assumption.

Unfortunately in reaching their Final Determination Ofwat did not support this approach and applied a one-sided adjustment financial penalty to Thames Water as a consequence. Ofwat have however put in place a Notified Item mechanism by which companies can submit climate change driven investment proposals during the plan period for re-assessment and we are currently working with Ofwat, the Environment Agency, UKCIP and leading academics assessing how to use the UKCP09 projections to support such a submission.

One of the key reasons for the difference in opinion about the approach to be taken with respect to climate change adaptation is the fact that Thames Water, in the absence of the publication of the UKCP09 Climate Change Projections, followed Government guidance to use best “available science.” However, Ofwat took the view that with the anticipated publication of new climate change projections this approach was invalid and companies should wait for the publication of these projections. This position was compounded further by the continual delay in the publication of what would become the UKCP09 Climate Change Projections and the expectations of the user community.

The concept of using best “available” science has been undermined as a consequence and has become a barrier to companies developing appropriate adaptation responses as there may be better data available in the future and perpetuates “just in time planning” seeking an unachievable certainty about the future in terms of size and timing of climate change impacts. There will always be better information about climate change in the future but this should not become a barrier to making decisions. Therefore we would urge the Government to direct regulators to accept proposals based on “the current best available science” at the start of planning cycles. Without this, given other externalities which can cause significant delay to scheme’s promotion such as the Town Planning system, there is a real potential that appropriate adaptation responses will be unacceptably delayed due to lack of funding.

9.2. *UKCP09 projections publication is not the end of the story*

Associated with the development of the UKCP09 projections there were misconceptions that they would reduce uncertainty about future climate change. Whilst the new projections manage the uncertainty associated with the underlying modelling and provide envelopes of probability distribution of future climates they do not reduce the associated uncertainty.

For business the publication of the UKCP09 projections is not the end of the process it is only the start. The amount of work and understanding required to apply the outputs has been severely underestimated not only by business but also Government and Regulators. Since 2009 we have been working with Ofwat, the Environment Agency, UKCIP and leading

Academics and consultants to understand how to apply the new projections to business planning for water resources to understand the thresholds and sensitivities of our systems to climate change. For more detail of this work see case study '*Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand)*' on [page 153](#).

9.3. Financing Adaptation Responses

It is important that water and sewerage services remain affordable. The costs customers pay should reflect the cost of delivering those services - the 'value of water' - but actions are taken to keep that as low as possible.

Additional costs or changes in the risk profile of the sector from legislation or regulatory changes directly affect the cost to customers. They also affect the attractiveness of the sector to current and future investors. Any changes should therefore take into account the impact they may have on financing the sector and ensure they do not introduce unnecessary additional costs to customers or current and future investors.

9.4. Cost Benefit Analysis

During the latest Periodic Review process, we identified and prioritised 50 wastewater proposals that needed to be undertaken before 2015. However, in the Final Determination Ofwat decided that only two should be funded because of the distribution of Public versus Private benefits which contributed to a positive cost benefit (CBA). As a consequence 48 wastewater schemes were not funded in the Final Determination due to a difference of opinion between ourselves and Ofwat over what benefits should be included in the assessment and therefore we will not be able to deliver them during this AMP period. In simple terms, if assets are protected so that operational costs to the business are avoided the customer will still have benefited. Conversely, if protection is not provided, the customer will definitely not benefit.

The Environmental Audit Committee report for the 2009-10 session identified that adaptation is expensive and that action is likely to be more effective and cost less if it is identified and planned for at an early stage. However, this benefit will only be achieved if realistic mechanisms for funding are available to those who need to deliver adaptation outputs.

There is a need for the CBA methodology to be reviewed as a matter of urgency and we understand Ofwat have plans to do so which we would support. There is also a need for it to be clear from the outset how the analysis will be applied and used to determine funding to ensure clarity, transparency and fairness.

More generally the use of CBA also raised questions regarding protection of critical infrastructure, should it be protected at any cost and if so how this should be funded? We would be very happy to work with Government to clarify this position to help remove further barriers to adapting to increased risk in the future and to deliver cost effective solutions on the ground (See also Section 9.7 Planning and Hampton Water Treatment Works).

9.5. *How much certainty is enough?*

As discussed in Section 9.1 there will always be uncertainty about how the size, rate of change and timing of climate change impacts. Because of this uncertainty there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. Lord Krebs (the Chairman of the Climate Change Committee) has highlighted that it is important to recognise that even well adapted societies (and this could read companies) will suffer some disruption from climate change as a consequence of natural variability. Our approach to understanding and managing the impacts of climate change is to try and ensure that these impacts are minimised as far as possible. To help regulated businesses manage uncertainty appropriately without the need to provide disproportionate levels of evidence there is a need for clear unambiguous guidance and leadership from Government and Regulators.

9.6. *Misalignment of Periodic Review, Water Resource Management Plans and Water Framework Directive cycles and requirements*

There is a misalignment of regulatory cycles for Periodic Reviews, Water Resource Management Plans and the Water Framework Directive in both terms of frequency and length of cycle. This together with lack of understanding of primacy of cycles is contributing to significant conflicts and confused messages and inefficiency in planning and delivery. There is a need for clear and pragmatic leadership from Government to provide clarification and direction. Given the current economic climate this is even more important than it has been. There is also a need to determine where primacy of decision making should lay. Does it lie in the decisions concerning Water Resources Management Plans that ministers make or in the allowances Ofwat make in price limits? Should ministers take account of Ofwat's views on funding in determining whether or not to approve or direct changes to a company's WRMP, or should Ofwat's funding decisions take account of the minister's views on the acceptability of the plan in its current form? Unless this key central issue is resolved there will always be inconsistent decisions made in the separate processes. The current review of the WRMP process being led by Defra is welcomed in this respect.



This situation could be further compounded if water companies are required to report again to the Secretary of State on their preparedness for the impacts of climate change rather than through existing regulatory frameworks.

The provision of information and general direction to those regulated organisations seeking to ensure that they adapt their businesses is not enough. There must be an a clear, transparent and unambiguous overarching framework which can be used by organisations in their planning processes which is accepted by Ministers, Government Departments and Regulators in advance of the each planning round. This framework should include details of how the different regulatory processes will be integrated when directing regulated businesses. We would be happy to work with Ministers, Government Departments and Regulators to overcome this problem.

9.7. Planning

The Government has stated that a new national planning framework for England will be introduced in due course. However, there are currently specific issues associated with the planning process and critical assets in terms of flooding resilience. For example at our Hampton Water Treatment Works (a key piece of critical infrastructure for London) we have identified the need to protect the site against increased flooding (including an allowance for climate change). However, in addition to the cost of delivering the flood resilience scheme there is a potential additional £20 million cost arising from the planning requirement to deliver like for like flood compensation storage. The cost is so high because of the location of the asset in west London where land availability is both limited and expensive. When CBA is used to assess the cost benefit of the solution it is not assessed as being cost beneficial when both the scheme cost and flood compensation cost is included. Currently compensation has not been sought nor provided through price limits by Ofwat. Therefore there is a potential risk that if agreement can not be achieved between Thames Water, the Environment Agency and local authority planners then the scheme may not be delivered due to the £20 million shortfall in funding.

There is also uncertainty about the level of flood protection that organisations should be planning for. Currently PPS25 states that a level of protection equivalent to a 1 in 100 year event plus 20% (the same value incorporated into the Ofwat methodology) should be used whilst the Cabinet Office (Cabinet Office document on flooding Strategic Framework and Policy Statement on Improving the Resilience of Critical infrastructure to Disruption from Natural Hazards (March 2010) have published an interim figure of 1 in 200 years.



There is a need for clarity and consistency across government on issues such as this if we are to justify and secure funding, avoid having to unnecessarily revisit completed protection assets and upgrade them at greater cost than if they had been delivered to a higher standard in the first place.

We have already identified that the Cost Benefit Assessment tool we are required to use coupled with Ofwat's consideration of public versus private benefit has already excluded the majority (only 2 out of 50 schemes funded) of proposed flood mitigation solutions that we identified for wastewater treatment works in PR09. In section 4, we have described the rigorous approach to assessing vulnerabilities of assets to flooding and how we prioritised them. In simple terms, if assets are protected so that operational costs to the business are avoided the customer will still have benefited. Although currently a barrier to the delivery timely and prioritised adaptation solutions we are working with Ofwat to see what lessons can be learnt from the application of the Cost Benefit Assessment tool in PR09. This is an important issue that we would strongly encourage Government to contribute to.

9.8. *Community Infrastructure Levy and possible unintended consequences!*

We have concerns that there may be unintended consequences associated with the Community Infrastructure Levy if it is applied too broadly as Local Authorities seek to generate income via this levy to fund their own adaptation work. For example if it is applied to developments that are designed/intended to provide adaptation responses any additional cost from the levy could make the schemes non-cost beneficial and as a result these schemes will not be funded or delivered under current criteria. We would propose that such schemes are explicitly excluded from the levy.

9.9. *Water Framework Directive Implementation*

Meeting the requirements of the Water Framework Directive is a key barrier/interconnectivity with respect to adapting to climate change. This Directive aims to ensure that all water bodies across Europe meet "good status" as a minimum and prohibits water body quality deterioration. However, in the Thames catchment, currently only 23.7% of water bodies meet the required standard despite the £billions spent on improvements by the water sector since Privatisation. Therefore significant additional and widespread measures are expected to be required in forthcoming years. We expect that we will need to undertake energy and resource intensive investment at our sewage treatment works to meet stringent in-river standards and develop new water resources to facilitate reductions in abstraction licences where the river is considered to be over-abtracted.



As the impacts of climate change materialise, in particular the lower summer rainfall, river flows are expected to decline; further driving the requirement for new resources while reducing the dilution of point and diffuse pollution sources leading to tighter discharge standards. Conversely, wetter winters will mean an increase in the volume of surface water the sewerage network and sewage treatment infrastructure will have to deal with. To prevent an increase in storm sewage discharges or sewerage networks, additional investment will also potentially have to be made into increasing the capacity of these assets. Delivering such responses will result in increased climate change gas emissions as well as increasing the cost of our services to the bill payer.

However, we believe that the delivery of appropriate and sustainable measures could be achieved through a robust enhancement of the disproportionate cost assessment methodology to better account for the wider impacts of implementing the Directive when considering whether a measure should proceed or not. In particular, the benefits assessment component of this process needs substantial improvement to adequately account for within class quality improvements. We would be happy to work further with the Government and the Environment Agency on this issue.

9.10. *Biodiversity, Habitats and Climate Change Impacts*

As the climate changes and so habitats and species change as a consequence, there will inevitably be a tension between protecting existing habitats and species in line with European Directives. This is not because organisations are not committed to ensuring compliance with such Directives but because climate impacts such as temperature rise are likely to impact on the life cycle of some species. For example Salmonids will be susceptible to relatively small increases in average temperature that will interfere with their ability to breed successfully. This will happen despite ensuring water quality objectives are achieved and habitat restoration is delivered. This could lead to significant wasted or inappropriate investment by organisations as a consequence. We would be happy to work further with the Government, the Environment Agency and other stakeholders to develop clarity on this issue.

9.11. *Adaptation Sub-Committee (ASC) on Climate Change*

The ASC presented its first report published in September 2010 “How well prepared is the UK for climate change?” in which it highlights a number of barriers to adaptation (some of which we have experienced and are highlighted in this section) and suggestions of how they might be removed:

Some of the barriers identified by the ASC include:

- behavioural barriers may delay complex decisions – particularly an issue for adaptation due to the uncertainty over future climate;
- market failure because of information failures, externalities and the public-good characteristics of some adaptation measures;
- institutional and regulatory barriers may directly constrain action or indirectly affect adaptation. Existing barriers which have been designed to achieve specific objectives may nonetheless have an indirect impact on adaptation, for example agricultural policies can affect the resilience of the natural environment; and
- financial constraints, especially where adaptation options involve upfront costs, may prevent adaptation from taking place. Individuals and business may not be able to afford these options, even if they make economic sense in the long term

The ASC identified a range of further action required by Government. They identified that action by local authorities, public sector agencies, businesses and individuals will be essential to ensuring that the UK is preparing adequately for a changing climate. Specifically they advised that the Government should work to remove barriers and provide stronger signals to enable action by others, including:

- establishing a process for defining adaptation outcomes, for example what level of flood risk is acceptable;
- helping deliver these outcomes by: (i) promoting greater capability and capacity in priority areas where progress has been slow, and (ii) ensuring decision-makers have practical tools and information to quantify key climate risks and manage uncertainties;
- ensuring that the new delivery arrangements, for example in land use planning and infrastructure provision, allocate responsibilities for adaptation clearly and provide for sufficient cooperation by organisations at landscape or catchment scale; and
- considering how upcoming policy reforms can support adaptation, for example in the White Papers on water, the natural environment and public health, and in any review of building regulations

We support the advice the ASC has given to Government particularly with respect to, but not limited to:

- critical National Infrastructure adaptation;



- establishing what level of flood risk is acceptable, in anticipation of drier summer and wetter winters;
- developing increased capacity of a water storage system (a response described as robust by the ASC)' and;
- the removal of barriers to effective adaptation, such as short term thinking, insufficient price signals and obstructive regulations, in order to incentivise and allow action

9.12. General Observations and Interdependencies

Although much of the information required to produce this report already existed it was not necessary available in the format required. We would like to highlight that Government assumptions about the resources and time required to complete this report in a meaningful way were significantly underestimated.

Contingency planning is related to the acute impact of existing natural hazards and the wider issues associated with civil contingencies for example the flooding experienced in 2007. As the external environment changes some risk sources transition from rare to ubiquitous including the risk of flooding associated with climatic change. The most economic treatment of a rare risk is effective disaster recovery whereas a risk that is more frequent should be accommodated within business as usual in the form of corporate resilience. Thames Water has an active programme of tracking all risk sources and targeting investment to be able to handle the risks of both today and tomorrow.

However, it is imperative that we identify these subtle changes in climate over time that we ensure that we keep our contingency plans up to date to adequately reflect these changes and their implications. In this respect we already work in partnership with a wide range of organisations both in terms of climate change and contingency (see Sections 5.2.1, 7.4 and 11.11) it has become apparent that there are opportunities for greater interaction between different interdependent stakeholders such as Supply Chain, Energy Companies and Emergency Services. We describe in Section 11 our ideas for taking this forward.

9.13. Section Summary

There will always be uncertainty about how the size, rate of change and timing of climate change impacts. Because of this uncertainty there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. There are concerns about timeliness of response (too early) or degree of response (too much) and wasted adaptation investment, which in a



regulated industry will ultimately impact on customer bills. However, this must be balanced with the need to encourage and ensure adaptation responses are in place in time.

Lord Krebs (the Chairman of the Climate Change Committee) has highlighted that it is important to recognise that even well adapted societies (and this could read companies) will suffer some disruption from climate change as a consequence of natural variability. Our approach to understanding and managing the impacts of climate change is to try and ensure that these impacts are minimised as far as possible. To help regulated businesses manage uncertainty appropriately without the need to provide disproportionate levels of evidence there is a need for clear unambiguous guidance and leadership from Government and Regulators.

During PR09 this position was compounded further by the continual delay in the publication of what would become UKCP09, the requirement to use the projections and the expectations of the user community. We believe that the concept of using best “available” science has been undermined as a consequence and has become a barrier to companies developing appropriate adaptation responses as there may be better data available in the future and perpetuates “just in time planning” seeking an unachievable certainty about the future in terms of size and timing of climate change impacts. There will always be better information about climate change in the future but this should not become a barrier to making decisions. Therefore we would urge the Government to direct regulators to accept proposals based on “the current best available science” at the start of planning cycles. Without this, given other externalities such a planning, population growth etc, there is a real potential that appropriate adaptation responses will be delayed due to lack of funding.

Associated with the development of the UKCP09 projections there were misconceptions that they would reduce uncertainty about future climate change. Whilst the new projections manage the uncertainty associated with the underlying modelling and provide envelopes of probability distributions of future climates they do not reduce the associated uncertainty.

For business the publication of the UKCP09 projections is not the end of the process it is only the start. The amount of work and understanding required to apply the outputs has been severely underestimated not only by business but also by Government and Regulators. Since 2009 we have been working with Ofwat, the Environment Agency, UKCIP, leading Academics and consultants to understand how to apply the new projections to business planning for water resources to understand the thresholds and sensitivities of our systems to climate change.



There is a need for the CBA to be reviewed as a matter of urgency and we understand Ofwat have plans to do so which we would support. There is also a need for it to be clear from the outset how the analysis will be applied and used to determine funding to ensure clarity, transparency and fairness. More generally the use of CBA also raised questions about the protection of critical infrastructure, should it be protected at any cost and if so how this should be funded? We would be very happy to work with Government to clarify this position to help remove further barriers to adapting to increased flood risk in the future and to deliver cost effective solutions on the ground.

There is a misalignment of regulatory cycles for Periodic Reviews, Water Resource Management Plans and Water Framework Directive in both terms of frequency and length of cycle. This together with lack of understanding of primacy of decision making is contributing to significant conflicts about objectives and inefficiency in planning and delivery. There is a need for clear and pragmatic leadership from Government to provide clarification and direction. Given the current economic climate this is even more important than it has been.

The provision of information and general direction to those regulated organisations seeking to ensure that they adapt their businesses is not enough. There must be an a clear, transparent and unambiguous overarching framework which can be used by organisations in the planning processes which is accepted by Ministers, Government Departments and Regulators in advance of the each planning round. This framework should include details of how the different regulatory processes will be integrated when directing regulated businesses. We would be happy to work with Minister's, Government Departments and Regulators to overcome this problem.

The Government has stated that a new national planning framework for England will be introduced in due course. However, there are currently specific issues associated with the planning process and critical assets in terms of flooding resilience and flood compensation e.g. Hampton Water Treatment Works (a key piece of critical infrastructure for London). We have identified the need to protect the site against increased flooding (including an allowance for climate change). However, the cost of meeting planning requirements from compensatory food storage is considerable and would make the scheme not cost beneficial. There is also uncertainty about the level of flood protection that organisations should be planning for. Currently PPS25 states that a level of protection equivalent to a 1 in 100 year event plus 20% (the same value incorporated into the Ofwat methodology) whilst the Cabinet Office have published an interim figure of 1 in 200 years. There is a need for clarity and consistency across government on issues such as this if we are to justify and secure funding, avoid having



to unnecessarily revisit completed protection assets and upgrade them at greater cost than if they had been delivered to a higher standard in the first place.

Meeting the requirements of the Water Framework Directive is a key barrier/interconnectivity with respect to adapting to climate change. This Directive aims to ensure that all water bodies across Europe meet "good status" as a minimum and prohibits water body deterioration. Despite the £billions spent on improvements by the water sector since Privatisation currently only 23.7% of water bodies in the Thames catchment currently meet the required standard. However, we believe that the delivery of appropriate and sustainable measures could be achieved through robust enhancement of the disproportionate cost assessment methodology to better account for the wider impacts of implementing the Directive when considering whether a measure should proceed or not. In particular, the benefits assessment component of this process needs substantial improvement to adequately account for within class quality improvements. We would be happy to work further with the Government and the Environment Agency on this issue.

The ASC identified a range of further action required by Government. They identified that action by local authorities, public sector agencies, businesses and individuals will be essential to ensuring that the UK is preparing adequately for a changing climate. Specifically they advised that the Government should work to remove barriers and provide stronger signals to enable action by others, including:

- Establishing a process for defining adaptation outcomes, for example what level of flood risk is acceptable;
- Helping deliver these outcomes by: (i) promoting greater capability and capacity in priority areas where progress has been slow, and (ii) ensuring decision-makers have practical tools and information to quantify key climate risks and manage uncertainties;
- Ensuring that the new delivery arrangements, for example in land use planning and infrastructure provision, allocate responsibilities for adaptation clearly and provide for sufficient cooperation by organisations at landscape or catchment scale; and
- Considering how upcoming policy reforms can support adaptation, for example in the White Papers on water, the natural environment and public health, and in any review of building regulations.

We support the advice the ASC has given to Government particularly with respect to, but not limited to:

- critical National Infrastructure adaptation;

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- establishing what level of flood risk is acceptable, in anticipation of drier summer and wetter winters;
- developing increased capacity of a water storage system (a response described as robust by the ASC)' and;
- the removal of barriers to effective adaptation, such as short term thinking, insufficient price signals and obstructive regulations, in order to incentivise and allow action



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10. Monitoring and Evaluation

In this section we describe how we will monitor and report on the progress of our adaptation programme. We explain how the management of climate change risks is embedded in our business. We describe how through the monitoring and risk assessment process we are able to review potential impact thresholds and incorporate them into future planning and risk assessment activities. We summarise how we expect to manage our response to climate change in a flexible way.

It is very difficult to determine the actual effectiveness of responses as their effectiveness will only ever be evident when they fail. Lord Krebs (the Chairman of the Climate Change Committee) has highlighted that it is important to recognise that even well adapted societies (and this could read companies) will suffer some disruption from climate change as a consequence of natural variability. Our approach to managing the impacts of climate change is to try and ensure that these impacts are minimised as far as possible.

However, by understanding the sensitivities and thresholds of our business to climate change impacts we can develop a clear baseline from which we can develop plans and deliver responses with greater confidence to meet clear objectives. We believe that is important to use a range of monitoring and evaluation mechanisms to ensure that a realistic assessment of the organisation is made with respect to climate change adaptation.

The following section describes a variety of mechanisms that Thames Water uses to monitor and evaluate the delivery of adaptation measures.

10.1. Delivery of our corporate climate change strategy

We have described in "Section 5. Approach" how we developed our corporate climate change strategy which included both adaptation and mitigation responses. To ensure that the strategy was delivered an action plan was also developed and agreed with delivery dates and clearly identified ownership and accountabilities. The action plan had over 40 action areas ranging from publishing and maintaining a climate change policy through to engaging with regulators and assessing the potential impact of climate change on asset flooding. Progress on delivery was monitored on an at least annual basis and by 2010 over 70% of the identified actions had been completed. In 2011 we will revise our strategy which will inform the development of our next 25 year Strategic Direction Statement and inform the development of the next Periodic Review business plan in 2014.



At the Executive level there is clear ownership of our climate change response. The member of the Executive who currently has responsibility for climate change is Richard Aylard who is the External Affairs and Sustainability Director.

10.2. Climate Change Policy

We will continue to annually review, update and publish our climate change policy to reflect progress made by the business and changes in external pressures. A copy of our climate change policy is on [page 123](#).

10.3. Annual Reporting

We currently assess and report externally on our response to climate change on an annual basis to Ofwat as part of the June Return process and through our voluntary Corporate Responsibility report. We will continue to report in this way going forward.

The June Return reporting process allows us to evaluate progress made against the specific outputs in our five year business plan that we have agreed with Ofwat. The monitoring of the delivery of our five year business plan is supported by an extensive and robust monitoring and assessment process. In addition to our regulatory reporting the Corporate Responsibility report enables us to report on our work with stakeholders. All data and information used in these reports are independently verified by third part auditors. Copies of our June Returns are available on the Ofwat web site (www.Ofwat.gov.uk) whilst copies of previous Corporate Responsibility reports can be downloaded from www.thameswater.co.uk.

We also voluntarily report progress on a wide range of sustainability issues including climate change through the Business in the Community Index and WaterUK Sustainability Indicators and will continue to do so in the future.

10.4. Research

As part of our ongoing need to understand and evaluate climate change impacts we are involved in a wide range of research projects (see case study *Climate Change Research 1997 to 2010* on [page 131](#)). We have contributed funding, expertise and helped to lead and steer the research on climate change through a number of different channels including United Kingdom Water Industry Research (UKWIR). The research programme has assessed key areas of our business (see Fig 2) and has included:

- general impacts;
- droughts;
- water availability;
- water quality;
- use of low quality water;
- stormwaters;
- regional impacts;
- transport; and
- mitigation measures and carbon accounting

The outputs of this research have enabled us to develop our understanding of the implications of climate change and also our contribution to it. This has informed our adaptation prioritisation and the development of adaptation responses.

Our research activities increased our knowledge of climate change, helped establish quantitative impacts, identify areas where there is uncertainty and enabled us to contribute and participate in the wider climate change debate. As importantly it has also allowed us to highlight to a wide variety of stakeholders the potential impact of climate change on the water sector.

10.5. Partnerships

It is essential that we understand the climate change issues that affect our business but we must also consider the wider societal impacts if we are to avoid mal-adaptation. To help understand and evaluate this wider context we have actively engaged with a wide variety of stakeholders to share information and learning including:

- Defra;
- Environment Agency;
- Ofwat;
- WaterUK;
- United Kingdom Water Industry Research;
- The Greater London Authority;
- The Tyndall Centre for Climate Change Research;
- Research Councils;
- London Climate Change Partnership;
- Climate Southeast; and



- The cross regional Three Regions Climate Change Partnership

10.6. Risk assessment

In Section 5.6 we described the integrated Business Risk Management (IBRM) process that we have in place for managing risk. Through this process we identify, assess and manage our corporate, strategic, operational and project-derived risk exposure including climate change.

In addition to ensure that we continue to understand the implications and potential impacts of climate change on our business we undertake detailed semi-quantitative risk assessments at least once every five years (see case study '*Expert Judgement Semi-Quantitative Risk Assessment*' on [page 139](#)). These risk assessments inform the development of our iterative 25 year forward look Strategic Direction Statements and our strategic business planning for each five yearly Periodic Review for Ofwat.

Ofwat's expectation is that investment in our asset base is both economic and efficient and that we are making balanced risk-based decisions, which considers the impact to both the business and our customers. We therefore have recently established a Risk & Value team which is tasked with ensuring that climate change impact is considered in our asset investment decision making, as part of 'business as usual' activities going forward.

10.7. PACT Tool

As an additional challenge/benchmark to the other monitoring and evaluation tools discussed in this section and as part of our contribution to the UK Climate Change Risk Assessment we have the PACT tool designed by Alexander Ballard Ltd (for more information see case study The PACT Tool on [page 171](#) and www.alexanderballard.co.uk). We have used this tool to help inform our assessment of where we currently stand in terms of adaptive capacity (both strategic and tactical) and also to suggest areas where we could/should focus on in the future.

10.8. Drought Planning

Because water resource management is integrally linked with drought management planning we need to ensure that we plan appropriately for the possibility of our region experiencing drought conditions (the frequency and severity of which may change due to climate change). We have prepared a Drought Plan (that is regularly reviewed) which describes our management plans for strategic and operational response to drought situations as required

under s39B of the Water Industry Act 1991 (WIA), as introduced by the Water Act 2003 (please refer to our Drought Plan for more details <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/11092.htm>).

As an organization we need to ensure that we deliver our stated Levels of Service which is a direct reflection of the combined effectiveness of our Water Resources Management Plan⁶ (WRMP) and our Drought Plan. It is important that the two sets of plans should be consistent with each other; therefore, both our Drought Plan and WRMP are based on the following key principles:

1. the need to maintain security of supply for our customers; and;
2. the level of restrictions imposed on customers is commensurate with our stated Levels of Service (LoS).

Table 7 illustrates the planned Levels of Service for water supply restrictions adopted by the Company.

Table A Planned Levels of Service Restriction Level	Frequency of Occurrence	Water use restrictions
Level 1	1 year in 5 on average	Intensive media campaign
Level 2	1 year in 10 on average	Sprinkler ban, enhanced media campaign
Level 3	1 year in 20 on average	Hosepipe ban, non-essential use bans requiring the granting of an Ordinary Drought Order
Level 4	Never	If extreme measures such as rota cuts in supply and the installation of standpipes were necessary their implementation would require the granting of an Emergency Drought Order

Table 7: Thames Water's Level of Service Restrictions

The fundamental assumption in our Drought Plan is that the risk to Levels of Service is acceptable when all WRZs are in supply demand balance. Where they are not then the WRMP will include actions to achieve this position. Because of its importance as the nation's capital and size of population, drought management of the London Water Resource Zone

⁶ Note: We capture the impact of climate change on water resources through our Water Resource Management Plan.



(WRZ) plays the central and pivotal role in the Drought Plan. As a consequence, company-wide measures will normally be triggered as a result of the water situation impacting on the London WRZ.

Table B Full range of demand side measures Measure	Description of measure	Company Level of service	Additional comments
Media /water efficiency campaign	Wide-scale media activity and advertising to encourage voluntary reduction in water usage	Level 1	
Enhanced Media /water efficiency campaign	Enhancement of above activity	Level 2	
Leakage reduction	Increased leakage activity / Network pressure management	Not applicable	
Sprinkler ban	Sprinkler ban	Level 2	Would normally be introduced at same time as the enhanced media/water efficiency campaign. Net effect is to reduce peak demand.
Hosepipe ban	Hosepipe ban	Level 3	If predicted then revised protocol will combine this measure with sprinkler ban. Net effect is to reduce peak demand.
Ordinary Drought Order	Application to Defra to grant Non Essential Use Bans, as part of an ordinary drought order application	Level 3	
Emergency Drought Order	Application to Defra to grant an Emergency Drought Order	Level 4	

Table 8: Drought Plan demand side measures for each defined service level restriction

The measures described in Table 8 are a sub-set of our baseline demand management, which is ongoing major activity comprising leakage reduction, metering and water efficiency. However, in accordance with our stated Levels of Service (see Table 7), unless there are good reasons for doing so, we will not impose water use restrictions on our customers (household and non-household). Therefore, the sequencing of the severity of the measures is commensurate with increasing risk to security of supply.

10.9. Supervisory Control and Data Acquisition

As part of the Final Determination of the PR09 price review we have secured essential funding for a major multi-million pound investment to upgrade our SCADA systems which will give us real-time data about our assets and their performance. This will help make monitoring and managing our assets more effective. SCADA is the name for the computer systems that monitor and control all aspects of wastewater and water treatment, collection and supply. The improvements which will be delivered through our Work, Asset Management and Information programme will deliver consistent, real-time data from operational sites and equipment, identify problems across our assets immediately so we can manage the impact on costs, customers and the environment straight away, enable us to take control of our assets remotely and give us the information we need to manage assets proactively, optimising cost, risk and performance.

The benefits of the programme will include:

- customers will see a quicker response to events such as burst mains and flooding;
- regulators will receive more reliable information about our assets and the investment necessary and our people in Operations will be able to do their jobs more efficiently;
- our Customer Service team will have better visibility of issues, and;
- asset Management will have better data on which to base decisions

The delivery of these benefits will provide data that will help identify changing trends in operational metrics that will help identify the magnitude and severity of climate change impacts. We will then be able to use this base line data to develop timely, targeted and appropriate adaptation responses.



10.10. Section Summary

As a business we assess and report externally on our response to climate change on an annual basis to Ofwat as part of the June Return process and through our voluntary Corporate Responsibility report.

The management of climate change risks is increasingly becoming embedded across our business and is evidenced in a number of ways in this document including:

- there is a senior member of the Executive team with explicit responsibility for climate change;
- a published climate change policy which is reviewed annually;
- we have produced a 25 year forward look at our business which explicitly includes climate change adaptation; and
- risk assessment and response plan development

By constantly reviewing the impact of climate change on our business using a variety of assessments and response development mechanisms including risk assessments the development of five and twenty-five year plans, continual asset monitoring and, research and external assessment, we expect to be able to manage our climate change risks.

We have established a Risk & Value team which is tasked with ensuring that climate change impact is considered in our asset investment decision making, as part of business as usual activities going forward.

The production of this report has not led to a fundamental change in the management of climate change risk within Thames Water. It has provided an opportunity for reflection and iterative refinement of our approach and understanding. We describe these refinements in more detail in Section 11 – ongoing development and further work.

11. Ongoing Development and Areas of Further Work

In this section we describe the activities we anticipate that we will be working on to improve our adaptation preparedness to the impacts of climate change. Although we have only just started the current AMP period we are already planning for the next Periodic Review Process (PR14) and this includes how we assess the impact of climate change on our activities and what our sensitivities and thresholds are in relation to them.

11.1. Climate Change and Carbon Strategy

In 2011 we intend to review and update our Climate Change and Carbon Strategy and this will be partly informed by the work we have undertaken to produce this Adaptation Reporting Power response. As a business we believe that it essential to undertake climate change adaptation and mitigation in parallel, they are not either or activities.

11.2. Updating our Strategic Direction Statement and preparing for PR14

As well as ensuring that our current AMP5 deliverables around flooding, sewerage and water resources are delivered we will between now and 2014 be preparing our business case for the next AMP period. As with PR09 climate change adaptation and mitigation will be a central integrated theme that the process will be considering. Also, as with PR09 we will be consulting with our stakeholders to ensure that they understand what the issues we will be facing are, what we proposed to do to manage them and also to directly comment on our plans.

In our Strategic Direction Statement published at the end of 2007 we identified our key climate change issues looking ahead 25 years to 2035 (see Table 9). We will keep these assumptions under regular review and will refresh our position and responses at least every five years starting with our preparations for PR14.

Adaptation		Mitigation	
2010-2015	2015-2035	2010-2015	2015-2035
<p>Assess and document the impacts of climate change on all our activities and operational sites</p> <p>Improve modelling capabilities including the incorporation of UKCP09</p> <p>Incorporate UKCP09 into the Water Resource Management Plan process</p> <p>Enhance sewerage design standards to accommodate increased flows</p> <p>Improve network modelling to enable better targeted capital expenditure in the future</p> <p>Review and improve the resilience of our operational sites to flood events</p> <p>Work in partnership with stakeholders to promote the understanding of climate change issues, options and solution delivery</p>	<p>Continue to monitor impacts of our activities and develop timely and appropriate responses</p> <p>Seek full consideration of all environmental impacts, including operational and embodied carbon in all proposals for environmental and service improvements</p> <p>Upgrade Water Treatment Works to treat poorer quality raw water as necessary</p> <p>Upgrade Wastewater Treatment Works to accommodate any loss of dilution capacity in receiving water courses as necessary</p> <p>Continue to design assets and plan operations to adapt to increased flood risk</p>	<p>Limit our contribution to climate change by reducing our Greenhouse Gas emissions by 20% compared to 1990 levels by 2015</p> <p>Understand, quantify and report our carbon footprint</p> <p>Improve our energy efficiency</p> <p>Reduce our overall carbon footprint through energy avoidance, substitution of fossil fuels, supply chain agreements and waste; elimination, reduction, reuse and recycling</p> <p>Increase the amount of renewable energy we generate</p> <p>Invest in research to develop low carbon water services</p> <p>Meet or exceed the requirement of planning policy to improve energy efficiency and the generation of renewable energy</p> <p>Seek appropriate recognition of the carbon mitigation obligation through price limits</p>	<p>Continue to deliver our equitable share of UK carbon reduction targets</p> <p>Seek further opportunities to achieve greater energy efficiency and renewable energy generation to reduce our carbon intensity</p> <p>Seek full consideration of all environmental impacts, including operational and embodied carbon in all proposals for environmental and service improvements</p>
Working with Government, regulators and stakeholders to develop cooperative and innovative solutions to climate change issues			
Full consideration of sustainability in the delivery of climate change adaptation and mitigation responses			

Table 9: Looking out to 2035

11.3. UKCP09

Associated with the development of the UKCP09 projections there were misconceptions that they would reduce uncertainty about future climate change. Whilst the new projections managed the uncertainty associated with the underlying modelling and provided envelopes of probability distribution of future climates they did not reduce the associated uncertainty.

For business the publication of the UKCP09 projections is not the end of the process it is only the start. The amount of work and understanding required to apply the outputs has been severely underestimated not only by business but also Government and Regulators.

Since 2009 we have been working with Ofwat, the Environment Agency, UKCIP, leading Academics and consultants to understand how to apply the new projections to business planning for water resources to understand the thresholds and sensitivities of our systems to climate change. It is our intention to share our finding with other companies, regulators and Government when complete to help inform the wider economy about the practicalities of using UKCP09. Going forward we will use UKCP09 for assessing the impacts of climate change on our wider business activities.

In addition, Infrastructure UK are working to establish a common set of planning assumptions which will include the impacts of climate change, economic growth forecasts, population growth forecasts in late 2011 which we hope will inform our planning for PR14.

11.4. *Adapting Sewerage Networks to Climate Change*

Our current programme to alleviate the risk to sewerage networks for the period 2010 to 2015 is based on delivery of conventional local sewer upsizing and offline storage to improve supply capacity and meet peak demand during heavy rainfall. Over the next 5 years, we plan to invest over £340m on our sewer network, alleviating more than 2,500 properties from the risk of sewer flooding. However, in the longer term we believe that it is unlikely that piped solutions in isolation will be practical or sustainable options. Therefore, in parallel with the conventional approach, we are investigating more sustainable catchment solutions for construction in 2015 onwards (see case study '*Adapting Sewerage Networks to Climate Change*' on [page 157](#)).

11.5. WRMP PI lessons learnt

A number of areas for improvement have been identified in regard to the production of the Plan, external engagement and the regulatory process. These improvements include:

- The need to approach the WRMP as a dynamic on-going process which will require continuous review and update to respond to stakeholder requests and expectations and keep the EA up to date with methodological developments including climate change; and
- The need for a central review of the alignment of the price review and water resource management processes with clear responsibilities of regulators to be defined.

11.6. Notified Items and Water Resource Adaptation

In the Final Determination Ofwat elected not to include water resources investment with a climate change driver within price limits. For the purposes of the PR09 Final Determination Ofwat noted that the companies, in evaluating costs necessary to balance water supply and demand, had not been able to utilise UKCP09 data sources and appropriate analytical tools published by the UK Climate Impacts Programme on June 18 2009. Ofwat stated that any increase in costs which a company can demonstrate, by applying appropriate analytical tools to UKCP09, is necessary to address the impact of climate change on balancing water supply and demand could be considered as a Notified Item. We are therefore currently developing our assessment of the impacts of climate change on water resources using the UKCP09 projections with Ofwat, Environment Agency and UKCIP in relation to the requirements of the Notified Item statement and Environment Agency Water Resource Planning Guidelines (see case study on 'Using UKCP09 (Evaluating Risk From Climate Change on Water Supply-Demand)' for additional information on [page 153](#)). This will also inform our approach to accommodating climate change impacts into future Water Resource Management Plans.

11.7. Risk

It is recognised within Thames Water that the potential impact of climate change upon our business operations is likely to be significant to the Water Industry. It is our intention to create methodologies, models and decision support tools to facilitate a far greater understanding of the current risk within our asset base and the residual level of risk remaining as a result of targeted capital expenditure. These models will incorporate best practice asset management tools, such as whole life costing and deterioration modelling; it is also our intention to incorporate climate change impacts into these processes.

11.8. Research

Knowledge and understanding of the impacts and implications of climate change must continue to develop if we are to improve the effectiveness of our responses. We have identified a number of areas where additional research would help improve our understanding of climate change impacts, thresholds, and sensitivities. Specifically we will be working with UKWIR to deliver two projects; one on the impact of climate change on water treatment and a second looking at the impact of climate change on wastewater treatment. In addition we have started and will be continuing to develop a framework for the use of the UKCP09 climate change projections. We intend to keep this area under constant review going forward.

11.9. Cost Benefit Analysis

As we highlighted in section 9 there is a need to further develop CBA to better reflect climate change needs and requirement to protect critical infrastructure. Hopefully this will be informed by the common set of principles for economic regulation work by Infrastructure UK and the Department for Business, Innovation and Skills. We would like to work with Government to clarify this position to help remove further barriers to adapting to increased flood risk in the future.

We also described earlier (in Section 5) that there is a specific issue associated with CBA with respect to assessing the cost of protecting critical assets and providing flood compensation. One way that we are exploring to overcome this issue is to work with the Environment Agency to determine the potential to deliver equivalency of flood compensation further up the catchment where land availability is greater and cost is lower. We have identified that there is a potential opportunity to explore alternative thinking in relation to the Lower Thames Flood Alleviation Scheme that the Environment Agency is promoting. We hope to develop this with the Environment Agency.

11.10. Supervisory Control and Data Acquisition

We will use SCADA to help identify changing trends in operational metrics that will help identify the magnitude and severity of climate change impacts. We will then be able to use this baseline data to develop timely, targeted and appropriate adaptation responses.

11.11. Contingency Planning

Contingency planning is related to the acute impact of existing natural hazards and the wider issues associated with civil contingencies for example the flooding experienced in 2007. Adapting to climate change on the other hand is associated with responding to chronic and more gradual change in the frequency, duration and intensity of weather.

However, it is imperative that we identify these subtle changes in climate over time that we ensure that we keep our contingency plans up to date to adequately reflect these changes and their implications. This is an area that we will keep under review going forward. The planned investment in our SCADA systems will contribute to this.

Some climate hazards, in particular extreme events, may have disproportionate, far-reaching or multiple effects on the economy and society. As highlighted by the ASC such events will potentially have systemic consequences but understanding of the potential for these systemic consequences is very limited. It is an iterative process which must be kept under constant review. This is an area where we would like to continue to work with Government, local authorities and other government agencies responsible for emergency planning to ensure that we collectively account for climate risks in our emergency planning responses.

As a response to the flooding that occurred in 2007 we have reviewed and enhanced our mutual aid programme whereby water companies have plans for the deployment of alternative water supplies in the event of supply interruptions under the Security and Emergency Measures (Water and Sewerage Undertakers) Direction 1998 (SEMD). Included in this is the agreement for companies to provide emergency equipment to affected areas. The process for Mutual Aid was revised and updated in conjunction with the review of the Security and Emergency Planning Manual taking into account the practical lessons learned during the provision of alternative water supplies in Gloucestershire in 2007. This will be kept under review going forward as climate change impacts become increasingly apparent.

11.12. Planning for Drought

Because water resource management is integrally linked with drought management planning we need to ensure that we plan appropriately for the possibility of our region experiencing drought conditions. It is likely that the frequency and duration of droughts will change as a consequence of climate change. We will continue to revise our Water Resource Management Plan using the latest climate change projections to ensure that we continue to meet our Levels of Service and that our Drought Plan (which describes our management plans for

strategic and operational response to drought situations) remains an appropriate response plan in times of drought. In addition, because of the fundamental links between the our Levels of Service, restrictions on water use and keeping customers and stakeholders well informed, we intend to review the current categories and sequencing of water use restrictions with the aim of building into them potential new opportunities for water use savings and greater clarity on their implementation from a customer perspective to reflect the revised provisions in the Flood and Water Management Act 2010.

11.13. Capital Project Delivery in AMP5 and Climate Change Adaptation

For the first time as part of the tender process for AMP5 capital delivery projects we challenged our suppliers to adopt our sustainability principles including climate change. In particular we have asked our Contractors to help us minimise our impact on climate change through energy avoidance, efficiency, renewables, emissions reduction and good carbon management, whilst ensuring that we adapt to the inevitable impacts of climate change on our assets and operations.

We have challenged our Contractors to deliver Works that are appropriately resilient to the expected changes in climate over the expected operational lifetime of assets delivered. As part of this, the Contractor shall have regard to guidance and climate change scenarios published in documents including, but not limited to:

- UK Climate Projections 2009 ('UKCP09') projections (published 2009);
- Planning Policy Statement 25: Development and Flood Risk ('PPG25') published 2006; and
- 'Planning Policy Statement: Planning and Climate Change – Supplement to Planning Policy Statement 1', published by the Department for Communities and Local Government (DCLG) (published 2007).

We will be working with our Contractors during the AMP5 period to deliver solutions that have taken climate change impacts into account as necessary.

11.14. Biodiversity, Habitats and Climate Change Impacts

As the climate changes and so habitats and species change as a consequence, there will inevitably be a tension between protecting existing habitats and species in line with European Directives. For example Salmonids will be susceptible to relatively small increases in average temperature that will interfere with their ability to breed successfully and so could be lost from a particular geographic location. This would happen irrespective of ensuring that water



quality objectives are achieved and habitat restoration is delivered. This could lead to significant wasted or inappropriate investment by organisations as a consequence. Therefore there is a need, for example, to ensure that the designation of habitats and species are kept under review with a move to proactive management of the impacts of climate change to allow effective species migration (where possible) and habitat adaptation management. This will not be easy task. Action is already being taken (see <http://www.parliament.uk/documents/post/postpn341.pdf>) but a more integrated and proactive approach is required which is consistent and accepts that the future is uncertain. We are willing to work with interested parties to move this issue forward and develop appropriate and sustainable solutions/responses.

11.15. Supply Chain and interdependencies

The impacts of climate change on our supply chain in its widest context goes well beyond the local and regional manufacturing and distribution centres. In the global economy our supply chain partners are likely to be dependent on other suppliers based in different countries around the world where the timing and severity of climate change may well be different to the UK. Although we may be disconnected from a climate event there is real potential for it to disrupt the ability of our immediate supply chain to deliver contracted goods and services.

It has therefore become apparent during the development of our response to the Adaptation Reporting Power Direction that we need to do more work with our supply chain to encourage them to understand climate impacts on their businesses and supply chain. Our Procurement Team have already started the dialogue with key suppliers and we expect to widen the scope and depth of the dialogue in the future.

We have already started to engage with Government on the issue of interdependencies and contributed to Infrastructure and Adaptation Project (2010) on the role of market, policy and regulation in encouraging long term resilience to climate change within the key economic infrastructure sectors in the UK (energy, water, transport and ICT) see <http://ww2.defra.gov.uk/environment/climate/sectors/infrastructure-companies/>. We intend to build upon this experience going forward.

11.16. Section Summary

In 2011 we intend to review and update our Climate Change and Carbon Strategy and this will be partly informed by the work we have undertaken to produce this Adaptation Reporting Power response. As a business we believe that it essential to undertake climate change adaptation and mitigation in parallel, they are not either or activities.



As well as ensuring that our current AMP5 deliverables around flooding, sewerage and water resources are delivered we will between now and 2014 be preparing our business case for the next AMP period. As with PR09 climate change adaptation and mitigation will be a central integrated theme that the process will be considering. Also, as with PR09 we will be consulting with our stakeholders to ensure that they understand what the issues we will be facing are, what we proposed to do to manage them and also to directly comment on our plans.

Since 2009 we have been working with Ofwat, the Environment Agency, UKCIP, leading Academics and consultants to understand how to apply the new projections to business planning for water resources to understand the thresholds and sensitivities of our systems to climate change. It is our intention to share our findings with other companies, regulators and Government when complete to help inform the wider economy about the practicalities of using UKCP09.

Going forward we will use UKCP09 for assessing the impacts of climate change on our wider business activities. We seek to understand the sensitivity of non-climate change related activity to this issue.

Our current programme to alleviate the risk to sewerage networks for the period 2010 to 2015 is based on delivery of conventional local sewer upsizing and offline storage to improve supply capacity and meet peak demand during heavy rainfall. However, during AMP5 we will investigate more sustainable catchment solutions for construction in 2015 onwards.

As a consequence of the Public Inquiry into our Water Resource Management Plan a number of areas for improvement have been identified, these improvements include:

- the need to approach the WRMP as a dynamic on-going process which will require continuous review and update to respond to stakeholder requests and expectations and keep the EA up to date with methodological developments including climate change; and
- the need for a central review of the alignment of the price review and water resource management processes with clear responsibilities of regulators to be defined.

It is our intention to create methodologies, models and decision support tools to facilitate a far greater understanding of the current risk within our asset base and the residual level of risk remaining as a result of targeted capital expenditure. These models will incorporate best



practice asset management tools, such as whole life costing and deterioration modelling; it is also our intention to incorporate climate change impacts into these processes.

Knowledge and understanding of the impacts and implications of climate change needs to keep developing if we are to improve the effectiveness of our responses. We have identified a number of areas where additional research would help improve our understanding of climate change impacts, thresholds, and sensitivities. Specifically we will be working with UKWIR to deliver two projects; one on the impact of climate change on water treatment and a second looking at the impact of climate change on wastewater treatment. In addition we have started and will be continuing to develop a framework for the use of the UKCP09 climate change projections. We intend to keep this area under constant review going forward.

As we highlighted in Section 8 there is a need to further develop CBA to better reflect climate change needs and requirement to protect critical infrastructure. We would like to work with Government to clarify this position to help remove further barriers to adapting to increased flood risk in the future.

During AMP5 we will use SCADA to help identify changing trends in operational metrics that will help identify the magnitude and severity of climate change impacts. We will then be able to use this base line data to develop timely, targeted and appropriate adaptation responses.

Contingency planning is related to the acute impact of existing natural hazards and the wider issues associated with civil contingencies for example the flooding experienced in 2007. Adapting to climate change on the other hand is associated with responding to chronic and more gradual change in the frequency, duration and intensity of weather. However, it is imperative that we identify these subtle changes in climate over time to we ensure that we keep our contingency plans up to date to adequately reflect these changes and their implications. This is an area that we will keep under review going forward. The planned investment in our SCADA systems will contribute to this.

It is likely that the frequency and duration of droughts will change as a consequence of climate change. We will continue to revise our Water Resource Management Plan using the latest climate change projections to ensure that we continue to meet our Levels of Service and that our Drought Plan (which describes our management plans for strategic and operational response to drought situations) remains an appropriate response plan in times of drought.



We have challenged our Contractors to deliver Works that are appropriately resilient to the expected changes in climate over the expected operational lifetime of assets delivered. We will be working with our Contractors during the AMP5 period to deliver solutions that have taken climate change impacts into account as necessary.

It has become apparent during the development of our response to the Adaptation Reporting Power Direction that we need to do more work with our supply chain to encourage them to understand climate impacts on their businesses and supply chain. Our Procurement Team have already started the dialogue with key suppliers and we expect to widen the scope and depth of the dialogue in the future.

We have engaged with Government on the issue of interdependencies and contributed to its Infrastructure and Adaptation Project (2010) and we intend to build upon this experience going forward.



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12. Conclusions

This report has described the current and future predicted impacts of climate change for Thames Water. It also illustrates how climate change risk is embedded within our business processes and describes our current and potential future responses with respect to adapting to climate change.

Some climate change impacts are unavoidable because of historical greenhouse gas emissions and will lead to variations in patterns and frequencies of droughts and other extreme weather events. Moreover, because of Thames Water's intimate dependence on the natural environment, the impacts of climate change will be felt throughout our business. As a consequence of these projected changes in future climate, we have identified that we will have to deliver appropriate adaptation measures in order to protect public water supplies and the environment in the future. This means working hard to ensure that we build our understanding of the implications and use it to make decisions based on sound science.

Our approach to climate change has not been developed solely as a response to the Adaptation Reporting Power Direction. Nevertheless the production of this report while not leading to a fundamental change in the management of climate risk within Thames Water has provided a valuable opportunity for reflection and iterative refinement of our approach and understanding.

In this report, we have described in detail our approach to risk both in terms of general business risk but also specifically climate change risk. We have demonstrated that our understanding of and response to climate change is embedded in our overall approach to managing business risk. In doing so, we have shown that we are committed to high standards of corporate governance in the management of key risks to the appointed business.

There will always be uncertainty about the size, rate of change and timing of climate change impacts. Because of this uncertainty, there is a concern that business, regulators, Government and politicians are unable to justify or are either reluctant or unable to support investment in adaptation responses. There are also concerns regarding the timeliness of response (too early) or the degree of response (too much) and potentially wasted adaptation investment, which for a regulated business will ultimately impact on customer bills. However, this need's to be balanced with the need to encourage and ensure adaptation responses are in place in sufficient time.



The risk to our business associated with climate change is only one of many and must not be considered in isolation. Indeed, there is a danger that if the focus is solely on climate change then perhaps other nearer term risks could be overlooked. However, by iteratively reviewing the impact of climate change on our business we expect to be able to flexibly manage our climate change response.

The challenge going forward will be to find a way of balancing in a sustainable way the challenges of climate change together with:

- what customers want and their willingness to pay;
- operational risks and business needs to operate efficiently and effectively;
- financing our business our business efficiently; and
- other environmental outputs including those related to water abstraction, effluent discharges and greenhouse gas emissions

This will not be easy. Nor can we achieve this balance working in isolation. We will therefore work positively with Government, regulators, customers and other stakeholders. If we work together, we will be able to adapt to the impacts of climate change successfully.

The indicative adaptation benefits from schemes delivered as part of the AMP5 programme will be in place by 2015. Delivery of adaptation projects beyond 2015 have yet to be developed, costed, funded or confirmed. Without funding it is unlikely that it will be possible for them to be delivered.

13. Key References

Adaptation Reporting Power Direction and Guidance,
<http://www.defra.gov.uk/environment/climate/legislation/reporting.htm>.

Adaptation Sub Committee report - How well prepared is the UK for climate change? (2010)
http://downloads.theccc.org.uk.s3.amazonaws.com/ASC/CCC_ASC_Report_web_1.pdf

Adapting to climate change in the infrastructure sectors – Summary Report (2010),
<http://www.defra.gov.uk/environment/climate/documents/infrastructure-pwc-summary.pdf>.

Cabinet Office document on flooding Strategic Framework and Policy Statement on Improving the Resilience of Critical infrastructure to Disruption from Natural Hazards (March 2010)
<http://www.cabinetoffice.gov.uk/media/349103/strategic-framework.pdf>.

Infrastructure and Adaptation Project (2010) on the role of market, policy and regulation in encouraging long term resilience to climate change within the key economic infrastructure sectors in the UK (energy, water, transport and ICT)
<http://www2.defra.gov.uk/environment/climate/sectors/infrastructure-companies/>

MWH Adaptation Framework,
<http://www.water.org.uk/home/policy/publications/archive/industry-guidance/asset-management-planning>.

National Infrastructure Plan 2010, <http://www.hm-treasury.gov.uk/d/nationalinfrastructureplan251010.pdf>.

Our plans for 2010-15, <http://www.thameswater.co.uk/cps/rde/xbcr/corp/our-plans-for-2010-2015.pdf>.

Planning Policy Statement 25: Development and Flood Risk,
<http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk>

PR09 Final Business Plan, <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6776.htm>.

Strategic Direction Statement *Taking Care of Water*
<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/5372.htm>

United Kingdom Climate Projections 2009 <http://ukclimateprojections.defra.gov.uk/>

Water Resource Management Plan 2010 to 2035,
<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/5373.htm>.

Tideway Tunnel Needs Report (2010),
<http://consense.opendebate.co.uk/files/thamestunnel/1-100-RG-PNC-00000-900007%20Needs%20Report.pdf>

Thames Water UKCIP Case Study (2010),
http://www.ukcip.org.uk/images/stories/Business/BCS_ThamesWater.pdf



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14. Appendices

Appendices

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Climate change policy

14.1. Climate Change Policy



Climate Change Policy

As a business we are embracing the need for sustainable development and consider it a key element in ensuring a better quality of life, now and for generations to come. We believe, and our customers and stakeholders agree, that a twin track approach of managing the unavoidable impacts of climate change on our business ('adaptation'), combined with a systematic reduction in our greenhouse gas emissions ('mitigation'), is essential if we are to overcome the challenges that climate change represents.

The projected impacts of climate change in south-east England will compound an already difficult situation in an area where water resources are already stressed and the population is increasing. We therefore need to find ways of responding to this challenge in a positive and equitable way and ensure that our responses contribute to our wider aspiration of becoming a truly sustainable business.

Our 25-year plan, *Taking Care of Water*, published in December 2007, identified the potential climate change impacts on our business and the actions that we believe we need to take to ensure that we mitigate and adapt effectively and responsibly.

To achieve these goals we will:

- Continue to implement our internal Climate Change and Carbon Management Strategy and regularly report progress.
- Work towards reducing our greenhouse gas emissions (carbon dioxide equivalent, 'CO₂e') by 20 % compared to 1990 levels by 2015.
- Calculate and annually report our greenhouse gas emissions in an open and transparent way.
- Calculate and publish our 1990 greenhouse gas emissions baseline.
- Secure our equitable contribution towards the 2050 greenhouse gas reduction goal established by the Climate Change Act 2008.
- Continue to look for ways of increasing the amount of energy we generate from renewable sources including biogas, combined heat and power, wind and hydro.
- Work with our business partners, supply chain and contractors to reduce our embodied carbon emissions.
- Build the latest climate change scenarios (UKCP09) from the UK Climate Impacts Programme into our business planning processes.
- Further assess climate change affects our operations and operational sites, and develop appropriate responses.
- Implement our Water Resource Management Plan to safeguard water supplies from the impact of climate change, with particular focus on leakage control, metering and water efficiency and the development of new water resources.
- Review and improve the resilience of our sites to flooding.
- Integrate climate change adaptation and mitigation into our Sustainability Strategy.

Climate change policy

- Continue to proactively engage with our shareholders, employees, customers, the Government, regulators, Regional Climate Change Partnerships and the local community to promote the understanding of climate change issues to help deliver effective and equitable responses.

We will review and update this policy annually to ensure it is aligned to changes in our understanding of climate change issues, best practice, regulatory drivers and our wider sustainability aspirations.



Martin Baggs
Chief Executive Officer

Thames Water Utilities Ltd
Adopted: January 2006
Last reviewed October 2010



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14.2. Strategic Direction Statement

The full Strategic Direction Statement '*Taking Care of Water*' can be downloaded at <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/5372.htm>.

Strategic direction statement

12 | Looking to the future: What the future holds

Climate change: Managing extremes

Global warming is likely to result in hotter, drier summers and milder, wetter winters. More extreme weather events (such as droughts or flooding) are also anticipated. The UK Climate Impacts Programme (UKCIP) has used computer models to estimate the likely changes in climate arising from different scenarios of greenhouse gas emissions. Predictions for the 'medium high' emissions scenarios are shown in the maps below.

As a result of climate change, we can expect greater demand for water in the summer as customers bathe, shower or water gardens more frequently. On average, about 6% of household water is used in the garden, but on hot days this can already rise to over 50%. Commercial usage of water is also likely to increase as air conditioning units are used to cool offices and IT systems, for example. Farmers and the wider agricultural industry are also expected to be affected; climate change is predicted to result in soils being able to hold less moisture, meaning that the industry is likely to require more water for crops.

Greater demand for water will come at a time when our existing water resources are under increasing pressure. Climate change will shorten the period when our groundwater sources can refill and will reduce summer rainfall. As a result, demand management activities (including metering and water efficiency programmes to encourage people to use water wisely) will be increasingly important in adapting to the impacts of climate change. New sources of water will also need to be developed.

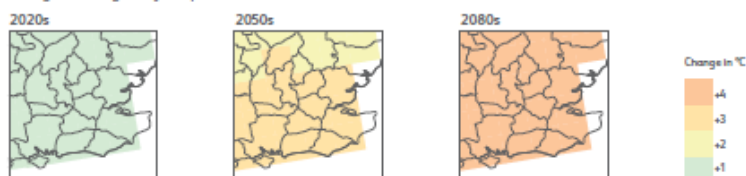
You can read more about the likely impacts of climate change on our business, how we plan to adapt to this, and how we will reduce our own contributions to global warming on pages 48 and 49 of *Taking care of water*.

Views of the future

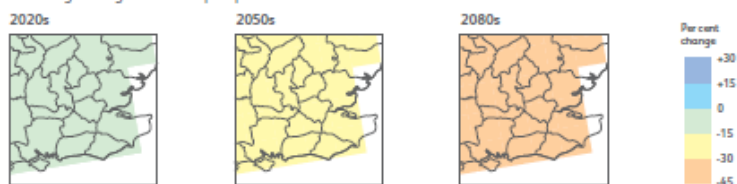
On the page opposite, we set out some of our thoughts about what life might be like in 2035 and how we should respond to these visions of the future. Over the pages that follow, we then explain what you have been telling us about your priorities for our services. We summarise what we learnt from our initial customer and stakeholder research (which included workshops, discussion groups and interviews). We also show how we've taken into account what you told us during the public consultation on our draft version of *Taking care of water*.

Likely changes in climate across south-east England under medium high emissions scenario

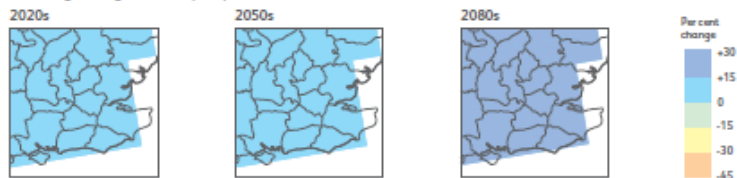
Change in average daily temperature



Percentage change in summer precipitation



Percentage change in winter precipitation



Source: Adapted from UKCIP02 Climate Change Scenarios (funded by Defra, produced by Tyndall and Hadley Centres for UKCIP)

Taking care of water | www.thameswater.co.uk

Strategic direction statement

Looking to the future: What the future holds | 13

Visions of the future: What might 2035 be like and how might we respond?



Our response

- Investigate potential for the development of household treatment plant (for water and waste) and associated tariff options. [32](#) [58](#)
- Work in partnership with stakeholders, such as developers, to provide treatment solutions that complement future sustainable communities. [30](#) [58](#)
- Develop meter technology to increase flexibility of use and remote, real-time information, and allow direct links to payment facilities. [32](#) [58](#)
- Develop demonstration projects with developers to showcase future water and wastewater services, particularly wastewater reuse and greywater recycling. [30](#) [58](#)
- Undertake feasibility study into innovative assets that limit land take and have potential to be developed underground. [58](#)
- Develop deeper understanding of service costs to enable critical evaluation of different business models. [60](#)
- Apply our expertise and passion for water to demonstrate thought leadership across the water and wastewater sector. [58](#)
- Develop demonstration projects in energy recovery and energy efficiency. [49](#) [58](#)
- Undertake feasibility studies for greater recovery of nutrients, energy and other materials from waste. [36](#)
- Recognise that innovation is not just about technology – it includes concepts, systems, regulation and more. [42](#) [46](#) [58](#) [60](#)
- Develop methodologies to better reflect all the costs and benefits of investment decisions and research projects for the future. [28](#) [34](#) [36](#) [46](#)
- Understand how we need to transform the way we think and act to meet the demands of the future. [58](#) [59](#)

X Denotes the page numbers relating to each bullet point

www.thameswater.co.uk | Taking care of water

Strategic direction statement

Climate change is already happening – how are we going to protect water services?

We are adapting now to inevitable changes in the climate.

Background

Some climate change impacts are unavoidable because of past carbon emissions. This will lead to variations in patterns and frequencies of droughts, and other extreme weather events. Summers are expected to become drier by 20–40% by the 2050s and maybe 50% by the 2080s; winters are anticipated to become wetter by 10–20% by the 2050s and up to 30% by the 2080s.

The impacts of climate change will be felt throughout our business, as the diagram below shows.



We will have to plan appropriate adaptation measures in order to protect public water supplies and the environment for the future. This means taking action now where necessary and working hard to ensure that we build our understanding of the implications, making decisions on the basis of sound science. This is particularly important in the areas of water resource planning (to protect the security of future water supplies such as rivers and groundwater) and sewerage design (to prevent sewer flooding, for example).

Key facts

- Using Environment Agency guidelines, we currently estimate that climate change will reduce available water for London by over 100 Ml/d by 2025, although this figure could increase as understanding of climate change develops.
- Climate change is expected to increase demand for water in hotter, drier summers, in addition to demands from population growth.
- Extreme rainfall events could occur three times as often by the 2080s. This would put customers' properties and our sites at greater risk of flooding.
- Sea level rise combined with water from storm events could raise the level of the River Thames by over two metres, putting many of our Tideway sewage treatment works at increased risk of flooding by the 2080s.
- Research funded jointly by the UK water industry and the Environment Agency indicates that the natural flow of the River Thames at Kingston in August could be reduced by as much as 25% during the 2020s.

Our response

In the medium term (2010–2015), we will:

- Assess and document the impacts of climate change (including extreme scenarios and weather events) on all activities and operational sites.
- Continue to develop approaches to modelling that are consistent with those developed by our stakeholders and build the latest climate change scenarios from the UK Climate Impacts Programme (UKCIP) into our planning processes.
- Implement our Water Resources Management Plan to safeguard water supplies from the impacts of climate change, with particular focus on leakage control, metering and water efficiency, and new water resources.
- Enhance our sewerage design standards to increase capacity for projected additional flows.
- Develop an enhanced sewerage network model to allow us to assess the impact of climate change on our network and to target capital expenditure more effectively.
- Review and improve the resilience of our sites to flood events.
- Continue to work in partnership with our stakeholders to promote understanding of climate change issues, options and solutions.

In the long term (2015–2035), we will:

- Continue to monitor the impacts of climate change on our activities and revise our adaptation responses as necessary.
- Undertake full consideration of all environmental impacts, including energy use, in proposals for adaptive responses in order to minimise associated increases in carbon emissions.
- Upgrade water treatment works to deal with poorer quality abstracted water as necessary.
- Upgrade sewage treatment works to deal with reduced capacity of rivers for effluent dilution as necessary.
- Continue to design our sites, and plan our operations, to adapt to increased flood risk.



14.3. *Climate Change Research 1997 to 2010*



Climate Change Research 1997 to 2010

Thames Water have contributed funding, expertise and helped to lead and steer the research on climate change through a number of different channels. We have been very active in leading the climate change research undertaken through United Kingdom Water Industry Research (UKWIR) and Water UK (see below).

We have also been very active working with and contributing funding to the work of UKCIP, the London Climate Change Partnership, Climate Southeast and the Three Regions Climate Change Partnership. In addition we have provided expert advisory support to Tyndall Centre and Defra lead projects.

The research undertaken that we have contributed since 1997 has covered a wide variety of critical areas including: General Impacts, Droughts, Water Availability, Water Quality, Use of Low Quality Water, Stormwaters, Regional Impacts, Transport, Mitigation Measures and Carbon Accounting.

The outputs of this research have enabled us to develop our understanding of the implications of climate change and also our contribution to it. This has informed our adaptation prioritisation and the development of adaptation responses.

The outputs from the research have increased our knowledge of climate change, helped establish quantitative impacts, identified areas where there is uncertainty and enabled us to contribute and participate in the wider climate change debate. As importantly they have also allowed us to highlight to a wide variety of stakeholders the potential impact of climate change on the water sector.

UKWIR Research - Completed UKWIR Climate Change Research 1997 to 2010

Workbook for Estimating Operational GHG Emissions, Version 4, 10/CL/01/12 - ISBN: 1 84057 557 3

Water Framework Directive: Sustainable Treatment Solutions for Achieving Good Ecological Status, 08/WW/20/3 - ISBN: 1 84057 501 8

Workbook for Estimating Operational GHG Emissions, Version 3, 09/CL/01/9 - ISBN: 1 84057 529 8



Assessment of the Significance to Water Resource Management Plans of the UK Climate Projections 2009, 09/CL/04/11 - ISBN: 1 84057 547 6

Carbon Accounting in the UK Water Industry: Guidelines for Dealing with 'Embodied Carbon' and Whole life Carbon Accounting, 08/CL/01/6 - ISBN: 1 84057 495 X

Carbon Accounting in the Water Industry: Non-CO2 Emissions, 09/CL/01/10 - ISBN: 1 84057 532 8

Climate Change - A Programme of Research for the UK Water Industry: Volume 1 - Summary Report, 08/CL/01/7 - ISBN: 1 84057 513 1

A Scoping Study to Identify Research Requirements to Assist the UK Water Industry in Dealing with Changing Patterns of Drought, 00/CL/07/1 - ISBN: 1 84057 187 X

Climate Change, the Aquatic Environment and the Water Framework Directive, 07/CL/06/5 - ISBN: 1 84057 434 8

Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: Recharge and Groundwater Level Impact Assessment, 07/CL/04/9 - ISBN: 1 84057 439 9

Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: Synthesis Report, 07/CL/04/10 - ISBN: 1 84057 443 7

Drought and Demand: Potential for Improving the Management of Future Droughts, 07/WR/02/2 - ISBN: 1 84057 444 5

Effects of Climate Change on River Flows and Groundwater Recharge: Guidelines for Resource Assessment and UKWIR06 Scenarios, 06/CL/04/8 - ISBN: 1 84057 431 3

Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: Interim Report on Rainfall-Runoff Modelling, 06/CL/04/7 - ISBN: 1 84057 421 6

Effects of Climate Change on River Water Quality, 05/CL/06/4 - ISBN: 1 84057 402 X

Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: Trends in UK River Flows 1970-2002, 05/CL/04/5 - ISBN: 1-84057-387-2



Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: Use of Climate Change Scenario Data at a Catchment Level, 05/CL/04/3 - ISBN: 1-84057-373-2

Climate Change Uncertainty in Water Resource Planning, 05/CL/04/4 - ISBN: 1 84057 389 9

Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: A Strategy for Evaluating Uncertainty in Assessing the Impacts of Climate Change on Water Resources, 05/CL/04/6 - ISBN: 1 84057 396 1

Effects of Climate Change on River Water Quality Phase 3 - Scoping Study, 03/CL/06/3 - ISBN: 1-84057-290-6

Climate Change and the Hydraulic Design of Sewerage Systems - Volume I: Climate Change Effects on Rainfall; IA - Climate Change and the Production of FSR, FEH and Year 2080 Rainfall Maps, 03/CL/10/1 - ISBN: 1-84057-360-0

Climate Change and the Hydraulic Design of Sewerage Systems Volume I: Climate Change Effects on Rainfall; IC - Seasonality Study, 03/CL/10/3 - ISBN: 1-84057-328-7

Climate Change and the Hydraulic Design of Sewerage Systems Volume II: Rainfall Data Production & Analysis; IIA - Time-Series and Design Event Update, 03/CL/10/4 - ISBN: 1-84057-329-5

Climate Change and the Hydraulic Design of Sewerage Systems Volume II: Rainfall Data Production & Analysis; IIB - Time-Series Rainfall – Disaggregation, 03/CL/10/5 - ISBN: 1-84057-330-9

Climate Change and the Hydraulic Design of Sewerage Systems Volume III: Sewerage System Modelling; IIIA - Changes in the Performance of Sewerage Networks, 03/CL/10/6 - ISBN: 1 84057 362 7

Climate Change and the Hydraulic Design of Sewerage Systems Volume III: Sewerage System Modelling; IIIB - Changes in Sewerage Run-off and Water Quality, 03/CL/10/7 - ISBN: 1 84057 363 5



Climate Change and the Hydraulic Design of Sewerage Systems Volume III: Sewerage System Modelling; IIIC - Changes in River Levels and Flows around the UK, 03/CL/10/8 - ISBN: 1 84057 364 3

Climate Change and the Hydraulic Design of Sewerage Systems Volume III: Sewerage System Modelling; IIID Increase in Mean and Extreme Sea Levels around the UK, 03/CL/10/9 - ISBN: 1-84057-345-7

Climate Change and the Hydraulic Design of Sewerage Systems Volume IV: Associated Topics; IVA - A Comparison between SOIL and HOST; Implications for Urban Drainage Design, 03/CL/10/10 - ISBN: 1-84057-331-7

Climate Change and the Hydraulic Design of Sewerage Systems Volume IV: Associated Topics; IVB - International Drainage Practices
03/CL/10/11 - ISBN: 1 84057 365 1

Climate Change and the Hydraulic Design of Sewerage Systems Volume IV: Associated Topics; IVC - Spatial High Intensity Rainfall, 03/CL/10/12 - ISBN: 1-84057-346-5

Climate Change and the Hydraulic Design of Sewerage Systems: Summary Report, 03/CL/10/0 - ISBN: 1 84057 361 9

Climate Change and the Hydraulic Design of Sewerage Systems: Volume I - Climate Change Effects on Rainfall; IB Sensitivity Report: Validation of HadRM3 and Comparison with HadRM2, 03/CL/10/2 - ISBN: 1-84057-327-9

Effect of Climate Change on River Flows and Groundwater Recharge UKCIP 02 Scenarios
03/CL/04/2 - ISBN: 1-84057-286-8

Uncertainty & Risk in Supply/Demand Forecasting - Volume A, 03/CL/09/1 - ISBN: 1-84057-284-1

Modelling the Effects of Climate Change on Water Quality in Rivers and Reservoirs, 01/CL/06/2 - ISBN: 1 84057 247 7

Review of River and Reservoir Water Quality Models for Predicting Effects of Climate Change, 00/CL/06/1 - ISBN: 1 84057 188 8



Effects of Climate Change on River Flows and Groundwater Recharge: Guidelines for Resource Assessment, 97/CL/04/1 - ISBN: 1 84057 010 5

UKWIR Active Research Projects

Climate Change Modelling for Sewerage Networks. This work is seeking to build on and update previous research completed in 2003 which looked at the impact of climate change on the hydraulic design of sewerage systems using the UKCP09 climate projections.

Water Treatment and Climate Change. This work will look at the potential impacts on existing water treatment processes and to identify generic sensitivities and thresholds where climate change could have an impact both negative and positive. It will also seek to identify potential adaptation options.

Wastewater Treatment and Climate Change. This work will look at the potential impacts on existing wastewater treatment processes to identify generic sensitivities and thresholds where climate change could have an impact, both negative and positive. It will also seek to identify potential adaptation options.

2011 Update of Workbook for Estimating Operational GHG Emissions used in June Return Reporting

WaterUK Research

Development of a climate change adaptation approach for asset management planning - A planning tool to support a common approach for the water industry to assess adaptation risks and their incorporation into asset management planning, December 2008.

Climate Change Partnership Research

We have and will continue to work with, share information/learning and undertake research with the London Climate Change Partnership, Climate Southeast and the cross regional Three Regions Climate Change Partnership and the Tyndall Centre. Over the ten years we have been involved with the regional climate change partnerships we have participated in, helped steer and contributed to a number of important studies on climate change adaptation ranging from understanding the impacts through to identifying practical adaptive responses. These have included:

Case study

- Wild weather warning: a London climate impacts profile (2009)
- Adapting to climate change: creating natural resilience (2009)
- Your Home in a Changing Climate (2008)
- A case study companion to the checklist for development (2007)
- Business as usual? (2006)
- A good practice guide for sustainable communities (2006)
- Lessons for London (2006)
- The impacts of climate change on London's transport systems (2005)
- London's warming: The impacts of climate change on London (2002)
- A checklist for development (2005)
- Rising to the Challenge (2000)

Tyndall Centre, DEFRA and EA Research

We have provided expert support to a number of Research Councils and Environment Agency projects:

- Government's Infrastructure and Adaptation Project (2010) - On the role of market, policy and regulation in encouraging long term resilience to climate change within the key economic infrastructure sectors in the UK (energy, water, transport and ICT)
- Assessment of Regulatory Barriers and Constraints to Effective Interconnectivity of Water Supplies (2010) - Defra R&D Technical Report WT0921/TR
- Engineering Cities: How can cities grow whilst reducing emissions and vulnerability (2009) - Stakeholder Advisory Panel
- Preparing for Climate Change Impacts on Freshwater Systems (2006) - Project Advisory Board.
- Regional Climate Impact and Response Studies, 2006 – Project Steering Group
- ADAPT (2003) - Project Advisory Board

Case study

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14.4. *Expert Judgement Semi-Quantitative Risk Assessment*



Expert Judgement Semi-Quantitative Risk Assessment

The semi-quantitative risk assessment methodology used by Thames Water is continually evolving and developing to reflect improvements in knowledge, understanding and the degree of adaptive resilience of the businesses assets and processes.

Our initial assessment was based on our 2004 analysis of business impacts of climate change. This used expert judgement but challenged and validated internally (through workshops) and externally by industry experts, regulators, academics and other stakeholders.

Our understanding from this assessment was directly fed into the development of the WaterUK planning tool to support a common approach to assessing adaptation risks related to asset management planning by Montgomery Watson Haza. Whilst this framework was not directly used it validated and supported the approach adopted by Thames Water for PR09 (see <http://www.water.org.uk/home/policy/publications/archive/industry-guidance/asset-management-planning>).

As part of the development of our final Business Plan for PR09 we developed a twenty-five year forward look or Strategic Direction Statement called *Taking Care of Water* where we sought the views of stakeholders and regulatory bodies through detailed research, customer surveys, regular meetings and public consultation (our largest-ever with over 2,600 individual comments). Included in this process was our view of the priority areas for adaptation identified through our semi-quantitative risk assessment. Our stakeholders broadly supported the approach to adapting to climate change that we proposed for the period 2010-15. The final version of *Taking Care of Water* summarised the responses received and how they had informed our thinking.

Any responses that were identified as requiring funding during the period 2010-15 were subjected to quantitative risk assessments as described in Section 5 of the Main Report.

As part of the ongoing and iterative process of assessing climate change risk we have further developed the WaterUK framework to incorporate assessment of:

Risks as either threats or opportunities

As part of the production of our response to the Adaptation Reporting Power we have used this revised semi-quantitative risk assessment framework incorporating expert judgement to

review our analysis of climate change risks to our business. The findings are consistent with those used to inform our response to PR09.

Semi-Quantitative Risk Assessment Methodology Components

1. Identify impact, pressure and consequence of climate change issues for each asset and operation.
2. Using expert judgement assess and score level of consequence, level of likelihood to determine level of risk with no adaptive responses where:
 - a. Level of consequence (i.e. what effect the impact would have) is characterised by :
 - i. Low = 1 – Short-term impacts that can be managed through contingency planning
 - ii. Medium = 2 - Impacts that can not be managed simply through contingency planning
 - iii. High = 3 – Significant failure
 - b. Level of likelihood (i.e. is adaptation going to be required) is characterised by:
 - i. Low = 1 – Not likely
 - ii. Medium = 2 - Likely
 - iii. High = 3 – Very likely
3. Determine risk using Red, Amber, Green where:
 - a. Red = Score between 9 and 6
 - b. Amber = Score between 5 and 3
 - c. Green = Score between 2 and 1
4. Based on the assessment in 2 above, characterise issues as Threats, Opportunities or Neutral where:
 - a. Red = Threat
 - b. Amber = Neutral
 - c. Green = Opportunity
5. Using expert judgement assess and score level of consequence, level of likelihood to determine level of risk in a world where adaptation response is unconstrained (e.g. by financial, regulatory, political, spatial limitations etc) it is possible to quantify the theoretical residual risk:
 - a. Level of consequence (i.e. what effect the impact would have) is characterised by :
 - i. Low = 1 – Short-term impacts that can be managed through contingency planning

- ii. Medium = 2 - Impacts that can not be managed simply through contingency planning
 - iii. High = 3 – Significant failure
- b. Level of likelihood (i.e. is adaptation going to be required) is characterised by:
 - i. Low = 1 – Not likely
 - ii. Medium = 2 - Likely
 - iii. High = 3 – Very likely
- 6. Assess residual risk (accepting that the consequence score will not change) using Red, Amber, Green where:
 - a. Red = Score between 9 and 6
 - b. Amber = Score between 5 and 3
 - c. Green = Score between 2 and 1
- 7. Assess potential adaptation options based on what is known today rather than the potential for the future. This helps to identify areas where development work could focus e.g. new disinfectants not susceptible to heat thresholds.
- 8. Feed findings into business planning process and wider challenge. Investment options assessed using quantitative methodologies.

Risk Overview

The findings of the risk analysis are fed into the business planning process and wider challenge and where an adaptation solution is proposed a full quantitative risk assessment would be undertaken.

The three prioritised areas of focus identified in *Taking Care of Water* were: water resource planning (to protect the security of future water supplies such as rivers and groundwater), sewerage design and flood resilience. This risk assessment, undertaken as part of the preparation of this report, reinforced the original assessment used in the preparation of our PR09 business plan and validates the actions being taken between now and 2015.



Business Area Assessed	Number of risks if no adaptation action taken			Potential of residual risk in an unconstrained adaptation world		
	Red	Amber	Green	Red	Amber	Green
Water Resources	19	12	3	0	24	10
Water Treatment	7	11	3	0	8	13
Water Networks	9	9	1	0	15	14
Wastewater Treatment	14	17	8	0	17	22
Wastewater Networks	14	10	6	0	10	20
Sludge	5	7	2	0	4	10
Totals	68	65	23	0	78	78

High Level Overview of Semi-quantitative Risk Assessment

Residual Risk

In an unconstrained world (i.e. no financial, political or regulatory constraints) it would be possible to positively manage climate change impacts in a way that would reduce these impacts and therefore reduce risk.

Based on what we know today about the issues highlighted, our analysis suggests that in an unconstrained adaptation world then it is potentially possible to manage all the high level red risks (68) down to either Green or at Amber. Not all risks are equal in terms of size and criticality of impact and this will allow the business further opportunities to manage the residual risk of climate change. Similarly the confidence in individual assessments is variable and we will seek to improve this where possible going forward. This assessment will inform further more quantitative risk assessment work during AMP5.

As previously stated in Section 5.2 of the Main Report, it must be remembered that the risk to our business associated with climate change is only one of many and must not be considered in isolation. Therefore to avoid the danger of focusing solely on climate change and perhaps other nearer term risks being overlooked we have incorporated climate change assessments into our long-term business planning processes.



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Case study

14.5. Climate Change Adaptation and Sustainability



Climate Change Adaptation and Sustainability

Responsible environmental management is core to the success of our business – our services depend on a healthy natural environment but we can affect the natural and built environments in all that we do.

Being truly sustainable means more than just protecting the environment. It means doing the right thing for people, for the planet and for our own performance, both now and into the future. We need to make sure that what we do today is right for tomorrow and that we do not disadvantage future generations or store up problems for the future in the process.

Addressing the long-term challenge of climate change adaptation is fundamental to our approach to sustainability.

Embedding climate change adaptation into our sustainability principles

In 2008, we developed a set of Sustainability Principles for our business. We are using these principles to help us plan and operate in an environmentally, socially and economically responsible way, and encourage our business partners to do the same.

Our principles are directly relevant to our planning and operations, and balance social, environmental and economic considerations - the fundamental basis of 'sustainability'. They were developed through cross-company workshops and signed off by our Chief Executive and his Executive Management Team.

The principles also complement the delivery themes of our Strategic Direction Statement (*Taking Care of Water: Our Plan for a Sustainable Future* <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/5372.htm>) and support the UK Government's five guiding sustainability principles.

Climate change is featured as the third sustainability principle which states that we will:

"Minimise our impact on climate change through energy avoidance, efficiency, renewables, emissions reduction and good carbon management, whilst ensuring we adapt to the inevitable impacts of climate change on our assets and operations"



Over the last 24 months, we have used our sustainability principles to develop company-wide policy on sustainability and environmental issues as well devise tools with which to assess the sustainability impact of our projects and programmes. The following sections provide more information on key activities and ongoing work.

Sustainability principles embedded in corporate policy

Our sustainability principles are featured in full in our Corporate Responsibility Policy and our Sustainable Procurement Policy, whilst our Environmental Policy includes the four environmentally focussed sustainability principles (including climate change adaptation). All of these policies are available on the Thames Water website at www.thameswater.co.uk.

Our Environmental Policy recognises that good environmental management (including climate change adaptation) is fundamental to our business, important to our customers and stakeholders, and integrated into our sustainability principles. This is echoed in our Corporate Responsibility Policy which recognises that our approach to sustainability means that future generations should not be disadvantaged by the actions our business takes today.

Our Sustainable Procurement Policy establishes that we will use our sustainability principles to improve our performance, that we will promote these to our suppliers and contractors, and that we will expect our suppliers and contractors to demonstrate a similar commitment to sustainability.

Assessing our 2010-15 Business Plan against our sustainability principles

In order to benchmark our sustainability performance, drive further progress, and help achieve the right balance between competing requirements, we developed and applied a strategic sustainability assessment framework to our draft and final business plans for 2010-15 during 2008 and 2009. This allowed us to better assess our performance and identify current and future challenge across our strategy and programme planning. We also used this assessment framework to assess what we thought the impact of Ofwat's Draft and Final Determinations were on our Final Business Plan.

Using the framework, we are able to assess all of our major strategies and programmes against each of our sustainability principles, including climate change adaptation and mitigation. Performance was scored from zero to five using clearly defined, challenging scores. These were accompanied by guidance on the meaning and implications of each score on the checklist itself.

Case study

In 2008, we assessed the breadth of our draft programmes against the framework, publishing the results in Part B of our draft plan. In 2009, we reassessed those programmes to review how performance has changed between the draft and final plan, and to identify any particular challenges for AMP5. We then reassessed the sustainability rating of our proposals after Ofwat issued their draft and final determinations on our plan.

Programmes assessed against our sustainability principles included: Efficiency, water efficiency, service and serviceability, new water resources, water quality enhancements, supply-demand waste, wastewater quality enhancements, sewerage networks alleviation, leakage programme, odour programme, metering and large projects.

Assessments have shown that, despite some variability across programmes, sustainability is a fundamental aspect of how we operate now and how we plan to operate in AMP5 and beyond. This was similarly recognised in our Strategic Direction Statement and draft business plan, which highlighted how we already practise sustainability in a number of ways, although this has not always been 'labelled' as such.

Assessments carried out against the climate change adaptation and mitigation sustainability principle as part of this work showed strongest performance from our efficiency, wastewater quality, water efficiency, water resources, wastewater supply / demand and sewerage networks alleviation programmes.

As an example, the sewerage networks alleviation programme assessment made a key contribution to addressing climate change:

- programme design demonstrated understanding of increased flood risk that climate change will bring and of the need to adapt the sewer network accordingly;
- alignment with our climate change and carbon management strategy was ensured and the programme had strong support from customers and stakeholders;
- Ofwat were supportive of the prudent approach adopted to climate change adaptation given the potential variation in climate change scenarios. Additionally, a review of the potential impacts of climate change on sewerage networks was commissioned once UKCP09 scenarios became available; and
- the programme also played a role in climate change mitigation - reducing incidents from sewerage networks will result in less requirement for related clean-up operations, lower resource use and less transport, so further decreasing emissions and embodied carbon

Case study

Our water efficiency programme similarly showed strong support for combating climate change, notably:

- our draft Water Resources Management Plan (dWRMP) explicitly took the impacts of climate change into account;
- the water efficiency programme encourages and incentivises customers to reduce their environmental impacts through lower water and energy use – a mitigation and adaptation response;
- it targets domestic, business/commercial customers and schools, recognising cultural diversity and the issues this raises (with impacts wide ranging and aiming to inspire cultural change with long-lasting benefits);
- it contributes to requirement of Climate Change Act 2008 to adapt assets/operations to the impacts of climate change; and
- the programme has additional indirect mitigation benefits – ultimately, less water will need to be put into supply resulting in lower energy use, a lower impact on the natural environment and a reduced carbon footprint

Embedding sustainability and climate change adaptation into our capital programme

In 2009, we reviewed the sustainability and climate change commitments and practice of all of the contractors bidding to manage the engineering projects that make up our multi-billion pound capital programme for 2010-15.

In particular, we wrote a contract specification that set out our approach to sustainability, climate change and carbon. This stated our related expectations of the contractors looking to work with us. We asked all of these contractors to demonstrate their understanding and experience in sustainability and climate change issues.

We also reviewed the backgrounds of the people being proposed as contractor leads on sustainability and climate change. All of the potential contractors were then scored on their level of experience and understanding in sustainability, climate change and carbon with results feeding into the overall assessment and award of contracts.

To further raise awareness of sustainability in the delivery of our capital programme, we set out a requirement for contractors to use our new project-level sustainability checklist to assess proposed engineering projects against our own sustainability principles. This means that future projects will now be scored against a range of environmental, social, ethical and

economic issues as part of the design process – including climate change adaptation. Scores from these assessments will feed in to a set of Key Performance Indicators in the year ahead. They will be used to review where we could improve our sustainability performance when designing and building new water and wastewater assets, like pipelines and treatment sites.

Sharing our thinking with the next generation

Sustainability and climate change adaptation are long-term issues. As part of this, we need to think carefully about the impact we are having on today's environment and society and to make sure that the next generation is prepared to responsibly tackle the environmental, social, ethical and economic challenges of the future.

As part of our commitment to better enable the next generation to achieve this and to engage others on our approach to sustainability and climate change, our Sustainability Strategy Manager spent time with students at Cranfield University and University College London in 2009 to discuss Thames Water's approach to sustainability and the challenges faced by the water sector. The sessions explored our approach to sustainability and climate change, the barriers to creating a truly sustainable water company, and what could be done to overcome these.

Environmental protection and sustainability

A truly sustainable Thames Water will bring benefits for customers, stakeholders, investors, the environment and society. We will do this by working to eliminate waste, reducing use of natural resources, operating more efficiently, continually improving performance, building employee pride, and meeting the expectations of our stakeholders.

Our approach is likely to include a focus on core issues related to people (health, safety, well-being, skills, ethics and employee engagement), the planet (environmental protection, natural resource management, climate change and zero waste), and the strength and reliability of performance now and into the future.

As part of this, we will ensure that sustainability and climate change are integral to the way we work – not a task in their own right, but simply an integral part of how we carry out our business. To help ensure this and build on the wide range of good practice that already exists, we will continue to develop targets and metrics against which to measure, report and drive our performance, and work in collaboration with other organisations to give our people the tools and the knowledge they need to make a difference.

Case study

Importantly, our approach will seek to go beyond our own staff, ensuring that our supply chain is equally committed to our long-term environmental and sustainability priorities.

We will report more on this as our approach develops and in our annual Corporate Responsibility reports.



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14.6. Using UKCP09 (Evaluating Risk from Climate Change on Water Supply-Demand)

Using UKCP09 (Evaluating Risk from Climate Change on Water Supply-Demand)

We have a legal duty to provide a secure supply of safe and clean water to our customers and every five years we are required to produce a Water Resources Management Plan (WRMP), which sets out how demand for water is balanced against the available supply over the next 25 years. This plan sets out how we will cope with increased pressure on water supplies from population growth and increased demand. To develop the most appropriate programme of interventions necessary to maintain a supply-demand balance and customer service, specific consideration is given to the impact of climate change on both demand and water resource availability.

As climate science and impact assessment approaches have evolved, we have used the most appropriate tools available to assess the potential impact on our future water supply-demand balance. This has included the use of UKCIP02 scenarios, guided by approaches set out in industry best practice in UKWIR06, to assess the climate change impact on surface water and groundwater resources as well as customer demand. However, while developing our current WRMP, and following completion of our business plan for AMP5 (2010-2015), a new set of climate projections and tools was issued in June 2009 by the UK Climate Impacts Programme (UKCIP), information referred to collectively as UKCP09. As a result, our economic regulator, Ofwat, noted that the scientific basis for our AMP5 investment case did not account for these most recent UKCP09 climate change projections.

To ensure that we can develop a reasonable, risk-based case for climate change driven investment, we are currently undertaking a programme of work to develop and implement impact assessment methodology that is consistent with Ofwat's requirements to:

- Engage Ofwat and the Environment Agency to discuss our assessment approach;
- Apply UKCP09 data sources utilising appropriate analytical tools;
- Predict supply using bespoke modelling driven by outputs derived from UKCP09;
- Produce a reasonable, risk-based analysis consistent with the range of projected outcomes derived from UKCP09; and
- Follow the current Environment Agency's water resource management plan guidance.

By developing and implementing an impact assessment methodology, we will be able to establish whether there is a robust business case to support climate change-driven investment within AMP5 and beyond.



Action Plan

Within the framework outlined above, the key element of our action plan is to develop and apply a methodology that accounts for the range of climate projections, yet enables pragmatic impact analysis of climate change on both supply capability and customer demand. As the UKCP09 information includes, for example, 10,000 projections of future climates for a given time period such as the 2020s, together with output from other climate change models, we must ensure that we make best use of the UKCP09 data and tools. Our aim is to enhance existing water resource planning risk analysis methods to enable more robust decision making. To ensure we achieve this aim and develop an appropriate methodology, we are working with recognised climate change experts including Newcastle University, The Walker Centre and UKCIP to support the development and peer review our work. Importantly, we are also engaging and working with our regulators, Ofwat and the Environment Agency, throughout the journey to facilitate their understanding and gain their support.

Ultimately, we are working towards delivery of an assessment of climate change impact on the water supply demand balance for the next 25 years that will facilitate risk-based investment decision making.

Current Position

We have carried out a robust assessment of the consequences of the UKCP09 information for London's supply-demand balance, demonstrating the uncertainty (headroom) in the potential impact. However, we are continuing to develop our approach to enable a more explicit consideration of the level of risk posed by climate change and so enable a more robust, risk-based investment case. In addition our assessment of climate change impact is being extended to cover our other water resource zones.

By engaging Ofwat and the Environment Agency, we working to gain the support of these regulators for our method of analysis of UKCP09 climate projections and build their confidence in the technical approach that will underpin any investment case. In this way, we are leading water industry development of climate change impact assessment on water supply-demand and helping to shape UKWIR and Environment Agency research that will underpin the water resource management planning guidance for AMP6 and beyond. Once complete we intend to develop a case study with UKCIP on our experience of using UKCP09 to share with the wider user community.



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Case study

14.7. *Adapting Sewerage Networks to Climate Change*



Adapting Sewerage Networks to Climate Change

Our Strategic Direction Statement published in December 2007 recognised that over the long-term, a drainage strategy founded upon local supply enhancements to alleviate the risk of sewer flooding would no longer be adequate to meet future demand. Factors such as increased flows from population growth, increased surface water run-off from loss of green spaces, reduced discharges to meet river water quality objectives and changing weather patterns as a consequence of climate change will require us to look at alternative and more sustainable drainage solutions to manage this risk.

The next five years (2010-2015)

Our current programme to alleviate the risk of sewer flooding for the period 2010 to 2015 is based on delivery of conventional local sewer upsizing and offline storage to improve supply capacity and meet peak demand during heavy rainfall. However, in the longer term we believe that it is unlikely that piped solutions in isolation will be practical or sustainable options. Therefore, in parallel with the conventional approach, we are investigating more sustainable catchment solutions for construction in 2015 onwards. Over the next 5 years, we plan to invest over £340 million on our sewer network, alleviating more than 2,500 properties from the risk of sewer flooding with around £9 million directly associated with climate change.

For AMP5 we have increased our design standard to alleviate the risk of sewer flooding to a 1 in 30 year event - our previous standard was 1 in 20 years. In preparing our business plan for the period 2010 to 2015, we reviewed the UKCIP02 climate change data to determine whether a further uplift to our design standard beyond a 1 in 30 year event was necessary. However, the analysis we undertook for the Thames region was inconclusive in terms of whether rainfall was likely to become more or less intensive in the future. Because of this uncertainty we decided that it would be better to hold our design standard at 1 in 30 years and to revisit this decision in the next AMP period once we had been able to fully analyse and understood the implications of the UKCP09 projections.

To understand the implications of UKCP09 we are currently participating in a UK Water Industry Research project that uses UKCP09 data to determine peak future rainfall events for various emissions scenarios and which could help us to set an appropriate design standard to incorporate climate change.

In addition, over the next 5 years we are planning work that will contribute towards developing approaches to allow us to sustainably adapt our sewerage network to climate change impacts including the roll-out of depth and flow instrumentation across our wastewater supply area. This technology will provide information about the performance of our network in real time, allowing us to further our understanding of how the system responds to storm events and the effects of growth in demand.

Beyond 2015

We are already thinking about our next business plan for the period 2015-2020, to continue our journey of adapting our sewerage network to climate change. In order to deliver more sustainable solutions at the catchment level in the future, we will need to progress a twin track strategy of managing demand as well as providing additional supply capacity.

In broad terms there are three main options for demand management: source control from New Development; source control to our existing sewerage networks (due to increased surface water run-off for example); and real time control within our existing network

For New Development, sustainable drainage provides an opportunity to minimise demand on our surface water and combined sewerage networks from green field sites and even to reduce demand from brown field sites (where legacy surface water run-off into surface water or combined sewers run could be very significant). The Flood & Water Management Act (2010) sets out clear responsibilities for local authorities in terms of adoption and maintenance of Sustainable Drainage systems. However, without adequate regulation and policing, poorly designed or maintained Sustainable Drainage systems (SuDS) could result in the connection of additional land and highway drainage to the public sewers. This will increase the risk of flooding as a consequence of higher flows. This is the type of innovative solution that will be considered although no decisions have yet been made.

Managing demand in our legacy sewerage networks is much more challenging. For Thames Water 'urban creep' (increased surface water run-off due to loss of green spaces) has been shown to be significant. Currently water companies have no statutory powers to address this problem and are reliant upon local authorities restricting the loss of green space through the planning process. Although it is not the responsibility of water companies to retrofit, own and maintain sustainable drainage systems to reduce surface water run-off, it may be possible to develop approaches that either provide support or change customer behaviour towards these assets. For example, it may be possible to revisit the way in which we charge for surface water drainage or prohibit drainage from abandoned and unoccupied properties or it may be



appropriate to offer customers a one-off payment to disconnect their surface water to discharge locally e.g. through soakaways.

Demand side measures will also help to reduce the scope and cost of supply side enhancements to our sewerage network and contribute towards alleviating sewer flooding risk. Therefore we plan to integrate the new performance information that we are currently gathering from our sewerage network with real time control systems, to manage the configuration and operation of our network during major storm events. We believe that a combination of demand side initiatives and real time control is a cost effective way of adapting our network to climate change and alleviating the risk of sewer flooding.

Developing Solutions

The Counters Creek catchment lies within the London Borough of Hammersmith & Fulham and Royal Borough of Kensington & Chelsea. One of the 'lost rivers of London', the Counters Creek now forms part of the local combined sewerage network. Over the last five years, approximately 1,500 properties across the catchment have suffered from sewer flooding during heavy rainfall events. Many customers have experienced flooding several times during this period and are now unable to obtain home insurance. This is a situation which our modelling has indicated will only get worse in the future if no action is taken.

The reasons properties in the area are at high risk of sewer flooding are: there are no local watercourses for excess surface water to drain to; excess storm water has to be pumped out into the River Thames; there has been 20% loss of green space in the wider area over the last 30 years; a very high proportion of the housing stock has basements; and the catchment is not isolated and receives excess storm water from other areas as far away as Brent in the north to Acton in the west.

We have been developing a scheme to alleviate the risk of these properties flooding which comprises a series of new storm relief tunnels discharging to the River Thames. However, we need to ensure the solution is appropriate, sustainable and resilient to future climate change impacts. To ensure this we are currently analysing excess historic rainfall events and data from the UKCP09 projections to determine the design criteria for rainfall events over this wide area. In addition, we are looking for opportunities to reduce surface water entering the sewer at source.



Case study

14.8. *Adaptation through Managing Water Demand*



Adaptation through Managing Water Demand

The management of both water supply and demand is often referred to as a 'twin track' approach. Through the effective and strategic management of supply and demand we can help the business adapt to the unavoidable impacts of climate change on water resources. This case study highlights three areas where we are seeking to manage customer demand without impacting on service to maximise the use of available water resources.

Metering

Metering is an effective way of managing demand for water, particularly as population grows and climate change puts pressure on limited resources. Our strategy is to ensure 80 per cent of homes are metered by 2025⁷. Our current plans have used the UKCIP02 climate scenarios and we will review their robustness once we have completed analysis of the likely future effects of climate change, based on recently published UKCP09 climate projections. The current indicative budget for our meter installation and replacement programme is approximately £83 million between 2010 and 2015⁷.

Thames Water has begun a programme to increase the proportion of domestic properties with meters from 28 to 37 per cent by 2015. This is the fairest way to pay and encourages careful use of water, as well as giving us useful information on patterns of water usage and potentially indicating leaks. We plan to meter a total of 375,000 additional homes over this period.

Currently our unmetered customers use an average of 170 litres per household per day. On average, the installation of a meter results in a 10% reduction in water consumption and as such, we anticipate that our metering programme will reduce demand by approximately 6.4 megalitres per day, by 2015. This will reduce pressure on existing water resource availability and help buffer some of the impact of climate change.

Where possible, we will fit meters at the same time as we replace water mains, to reduce costs and minimise disruption to customers. However, this is not always possible and we expect to install nearly 140,000 on an *ad hoc* basis when requested directly by customers. Our integrated demand management approach combines mains renewal, meter installation and water efficiency activities into a single programme that will see all three elements delivered in a coordinated and cost effective manner, where disruption is minimised.

⁷ The results of a public inquiry into our revised draft Water Resources Management Plan when known will potentially affect our proposals.



Nearly 900,000 additional people will benefit from inclusion in our metering programme by 2015. We will initially focus most of our work in London, Swindon and Oxfordshire, where there is the greatest potential shortfall between local water needs and the volume we can supply. As part of the process we will provide all newly-metered customers with advice and assistance to help them control their water usage and bills. Low income customers will be provided with an enhanced programme of water efficiency advice.

For more information about metering please follow this link

<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/551.htm>.

Delivering in Partnership

RE:NEW⁸ (formerly the Home Energy Efficiency Programme HEEP) is a pan-London, homes retrofitting scheme aimed at reducing both residential carbon dioxide emissions and water use. Initial trials and demonstration projects of practical energy and water efficiency activities have informed the design of the model enabling roll-out of a large-scale homes retrofit programme for London in the medium-term.

Energy and water consumption are intrinsically linked. Customers heating water in their homes for cooking, washing and bathing generates nearly seven times the level of carbon emissions as the water sector emits in delivering safe clean drinking water and taking away wastewater. Any action that can be taken to reduce the consumption of hot water in the home will save customers money on their electricity and gas bills and reduce their carbon footprint. This financially benefits all water customers even if they are not metered and it will also reduce water consumption (a climate change adaptation benefit).

Thames Water is involved as a key project partner in the RE:NEW programme, providing water efficiency devices for installation during domestic audits and training for installers. We expect to contribute approximately £250,000 to this phase of the project. We have been involved in the previous trial and pilot phases of this work for several years, working in partnership with the Greater London Authority, London Development Agency and London Councils.

This unique project will deliver energy and water efficiency audits on a large-scale, across 32 London boroughs. Its delivery will help tackle the 38 per cent of London's carbon emissions that come from homes. It is anticipated that this phase of the programme will visit a minimum of 45,000 properties across London by March 2012, benefiting over 100,000 people.

⁸ As a consequence of the Spending Review this project is currently under review.

Case study

The potential water savings from this phase of the project are expected to be 1 MI/d. Delivery of this phase will commence in early 2011 and continue across selected areas until March 2012. For more information about RE:NEW follow this link <http://www.lda.gov.uk/projects/renew/index.aspx>.

Educating the public

We are working in partnership with World Wildlife Fund (WWF) and Waterwise on a large-scale water £100k efficiency retrofit and behavioural change campaign called 'Save Water Swindon'. This year long project, launched in June 2010, is challenging people in Swindon to reduce their daily water use, from 164 to 130 litres per person. This is in line with the Government's aspirational target set out in their water strategy for England; 'Future Water'. Other key messages of the project include; getting residents to link their water use back to the natural environment, energy use, and potential money saving incentives for saving water (and energy).

The project is the first partnership project of its kind, and is being supported by WWF, HSBC, Swindon Borough Council and sustainable development advocate, Kevin McCloud. We expect to engage with approximately 20,000 people through this project; around 10% of the town's population, saving 0.3 MI/d.



For more information or to get involved follow this link <http://www.savewaterswindon.org.uk/>.

Working with Schools

An effective water management programme in a school can help reduce water usage, associated costs and environmental impact. The Department for Children, Schools and Families (DCSF – now part of the Department for Education) has estimated that schools spend around £70m a year on water and wastewater services - an average of over £2,500 per school.

On average, primary schools use 7m³ of water per pupil per year, with secondary schools using 11m³ per pupil per year (Water Watch 2005)⁹. The DCSF suggests that with careful water management, most schools can reduce this figure to around 4m³ per pupil per year, benefiting the school's budget and environmental performance.

⁹ 1 M³ equals 1000 litres.

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To support schools in reducing their water use we have developed the 'Wise up to Water' website and a range of teaching resources. 'Wise up to Water' seeks to unite schools, from first-year pupils to governors, under the common goal of saving water. It supports schools in their work towards the Sustainable Schools, Eco-schools and/or Sustainable Learning schemes and provides behavioural, technological and financial advice.

The website sets out the reasons to save water, and includes:

- A self-audit questionnaire that automatically generates water-saving tips based on the answers entered
- Guidance on how to produce a water action plan
- Ideas on how to get the whole school and wider community involved

For more information follow this link:

<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9691.htm>.

Additional information

For more information about saving water in the garden work follow this link

<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9689.htm>.

For more information about saving water at work follow this link

<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9690.htm>.



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14.9. *The Thames Tunnel and Climate Change*

The Thames Tunnel and Climate Change

The Thames Tunnel, a full-length storage tunnel to convey combined sewer overflow (CSO) flows from West London onwards for treatment at Beckton sewage treatment works, is one of three major projects required for the UK to comply with the Urban Waste Water Treatment Directive (UWWTD) and meet the river water quality objectives of the Water Framework Directive (WFD). The other two projects are (a) the London Tideway Improvement schemes to extend and upgrade the five major sewage treatment works (STWs) at Mogden, Beckton, Crossness, Long Reach and Riverside which discharge directly into the Thames between Teddington and the estuary east of London, and (b) the Lee Tunnel from Abbey Mills to Beckton STW. The three projects will have the effect of capturing for treatment approximately 96% of all the CSO overflows predicted to spill into the Rivers Lee and Thames from the Beckton and Crossness catchments in 2021. The STW projects will also improve, year round, the quality of the treated effluent discharging into the River Thames.

The CSO control achieved by the projects is based on an analysis of the rainfall between the years 1970 and 2003, from which several series of rainfall events were selected including a summer series comprising 154 events to assess compliance to water quality requirements and a 'typical' year selected to simulate combined sewer overflow (CSO) capture. The series of events were selected to show the performance of the projects with the wide range of rainfall patterns, storm intensities and durations found in the rainfall record. The rainfall patterns for the seven years 2003 to 2010 were also analysed and when added to the 34 year storm series it was found that the selection of the 'typical' year rainfall pattern would not change. The various series of rainfall events were used in hydraulic models of the Beckton and Crossness catchments to simulate the flows in the sewer networks under the varying storm conditions. The Typical Year was used to estimate the typical annual volumes, duration and number of spill events for each of the 57 CSOs identified in these catchments discharging into the River Thames and River Lee between West London and Beckton STW. The Environment Agency identified 36 of these 57 CSOs as unsatisfactory and requiring action to control the discharges.

These hydraulic models were calibrated using readings from rain gauges and actual sewer flow and STW flows and relating these to impermeable areas, population data from local authorities/National Office of Statistics, infiltration assessments and other factors. This provided the basis for validating the models as representing existing conditions, and projecting the situation forward to 2021 for the design of the Thames Tunnel. The tunnels were originally sized, in length and diameter, to achieve a storage volume of approximately 1.6 million cubic metres. This capacity was shown to be necessary by the sewer hydraulic

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modelling to reduce spill frequencies from the 36 unsatisfactory CSOs to no more than four events per annum to enable compliance with the UWWTD and to contribute to meeting the water quality objectives of the WFD.

The design horizon for the Thames Tunnel is 120 years. Projections from current research are that the climate of the UK will change over time in several ways, particularly in seasonal rainfall volume and ambient temperatures. The sensitivity of the tunnel scheme in achieving CSO control with rainfall changes has been assessed, and further analysis will be undertaken, to ensure that the design remains robust, flexible enough to accommodate the projected changes in climate and remains valid and fit-for-purpose throughout its lifetime.

The sensitivity assessment for the project included projecting population forward from the 2021 basis to 2050 and rainfall trends forward to 2080, these dates being the limits of demographic and climate change projections available. Rainfall patterns are projected to change, generally with greater winter rainfall volume and lower summer rainfall volume. Inserting the projected population increases for 2050 and the median climate projection of 2080 rainfall patterns for the Typical Year into the hydraulic models indicated that between 2050 and 2080 (a) the winter CSO spill volumes will increase, but still with approximately 93% of the predicted CSO spills captured by the tunnel system, and (b) the CSO spill frequency will rise to 5 to 6 events per annum at several of the CSOs controlled. Future projects such as local CSO controls and further improvements in STW capacity and performance could be implemented as required. Thus the tunnel will continue to comply with the requirements of the UWWTD as agreed with the Environment Agency, and achieve a high level of protection to the River Thames and River Lee from the effects of CSO discharges.

In the future it is projected that the mean air temperature (and by inference the river water temperature) will be higher on average than today. Higher temperatures could result in the river containing less dissolved oxygen, particularly during summer months. The river would therefore be more susceptible to adverse impacts from CSO operation if no tunnels are built. The Thames and Lee Tunnel projects will not only ensure compliance with the WFD today but will also reduce the impact of CSO discharges occurring during higher water temperatures periods, thereby protecting the water quality of the river in the future.

In line with the recent consultation on the draft National Planning Statement for Wastewater we are planning further climate change impact sensitivity analysis to inform our final proposal.

For more information on the Thames Tunnel please follow this link:

<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/10115.htm>



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14.10. *The PACT Tool (benchmarking organisational adaptive capacity)*

The Pact Tool (benchmarking organisational adaptive capacity)

As an additional challenge/benchmark to the other monitoring and evaluation tools discussed in this report and as part of our contribution to the UK Climate Change Risk Assessment we have the PACT tool designed by Alexander Ballard Ltd (for more information on the PACT Tool go to www.alexanderballard.co.uk). Thames Water has used this tool to help in our assessment of where we currently stand in terms of adaptive capacity (both strategic and tactical) and also to suggest areas where we could/should focus on in the future.

PACT can help an organisation benchmark its adaptive capacity both internally between one assessment and the next and also externally against specific organisations where data is available or using aggregated data for sectors of the economy as with the UK Climate Change Risk Assessment. The PACT framework assesses organisational response to climate change adaptation using six different response levels (RL) which increase in the complexity of the way climate change can be responded to:

- RL1, "Core business focused" – organisation simply looking at business as usual;
- RL2, "Stakeholder responsive" - organisation spotting the changing needs of major stakeholders, so avoiding costly emergency actions to comply under duress;
- RL3, "Efficient management" – the organisation is looking to take advantage of any commercial opportunities such as carbon trading;
- RL4, "Breakthrough projects" - organisation explore issues in depth, to look beyond the status quo, to build a base of understanding of issues and options from which leaders can responsibly set the organisation's future direction. Focusing on areas where win : wins with the organisation's other priorities are possible, such projects potentially offers multiple benefits - e.g. costs, revenues, relations with stakeholders, reputation;
- RL5, "Strategic resilience" - at this level the organisations focus is on enhancing the organisation's resilience to climate impacts as they grow in intensity and to the energy constraints that are beginning to bite. At RL5, climate change due diligence and risk management becomes a central business concern; and
- RL6, "Champion organisation" – at this level the organisation addresses the context that is changing

The PACT process gathers and organises information about progress along nine pathways - organisational capacities which are considered to be necessary for organisational adaptive capacity improvement:

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1. **Awareness** - The grasp of what climate change means for society, for the organisation and its mission, and for particular areas of responsibility, now and into the future;
2. **Agency** - The capacity to spot, prioritise and develop opportunities for meaningful and timely action on climate change;
3. **Leadership** - The capacity of a formal leadership team to develop a strategic vision and to engage with, support, direct and legitimise its implementation;
4. **Agents of Change** - The capacity to identify, develop, empower and support individuals or groups of change agents to become an effective 'ecosystem' of champions;
5. **Working together** - The capacity to involve, respect the needs of, learn from, and act in collaborative partnerships with internal and external groups;
6. **Learning** - The capacity to identify and make sense of the results of activities and to communicate it to improve procedures, strategies and mission;
7. **Managing Operations** - The capacity to embed procedures to get to grips with climate change in a systematic way to ensure that intentions and policies turn into action;
8. **Programme scope and coherence** - The capacity to place projects within an overall programme of action suited to the scope of what the organisation is trying to achieve; and
9. **Expertise** - The capacity to recognise access and deploy the necessary skills, understanding and technical and change expertise to make the biggest difference.

The way each of these nine pathways needs to be activated varies dependent on the response level an organisation is working at. For an organisation to reach the next level in the PACT it is not simply a case of doing more of the same thing but of doing things differently by both reinforcing the current position and pushing the boundaries to move ahead to the next response level.

Whilst the tool can help an organisation identify where it currently is in terms of organisational adaptive capacity it is not a substitute for other business making decision processes. This is because climate change is only one of many issues (e.g. affordability, profitability, funding, sustainability, regulatory compliance etc) that an organisation needs to take into account. PACT allows businesses to make an assessment of its adaptive capacity and highlight opportunities for enhancing adaptive capacity which can feed into and inform strategic decision making.

